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THE

SUGAR CANE:

A Monthly Magazine,

DEVOTED TO THE INTERESTS OF THE SUGAR CANE
INDUSTRY.

VOLUME I.

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☞ The writers alone are responsible for their statements.

ADDRESS.

In thus introducing a new Periodical, intended to represent the interests of an important industry, its conductors are able to state that there is no other at present existing with whose interests it is likely to clash; but that it comes to supply a want long felt and acknowledged.

The greatness and importance of the interests involved in the culture and manufacture of sugar it is difficult to over-estimate, and hitherto these interests have been without any special organ in the English press, Home or Colonial.

This position, thus vacant, "The Sugar Cane" intends to take up and maintain.

It aspires to be the medium of communication between those directly interested in the growth of the cane and the manufacture of sugar in all parts of the world.

The practical co-operation of planters in all cane growing countries is earnestly requested; the pages of "The Sugar Cane" will be open to them for the interchange of the results of their experience on questions of cane culture and the extraction of sugar. Carefully collected and verified data, relating to the effects of manures, of draining, or irrigation, will at all times find place. It will also be a proper channel for questions on subjects of general interest.

The interests of Colonial planters and British refiners being rarely if ever conflicting, both may be truly represented in the pages of the same journal. Of all the manufactures at present carried on in this country, that of Sugar Refining stands most in need of the advantage obtainable from the early publication of information respecting every new appliance or improvement in materials or apparatus. This it will be the aim of "The Sugar Cane" to supply.

"The Sugar Duties" have been the *vexatio questio* with Chancellors of the Exchequer for many years. The conductors of "The Sugar Cane" are convinced that there is but one satisfactory solution of the difficulty—viz., their total repeal. But until this is attained, they will support the system, by the operation of which all concerned shall stand in the nearest relative position to that in which they would be placed by perfect freedom of trade.

Of all our sugar-producing colonies, the West Indies are the most dependent on cane culture as their staple, and the prosperity of their sugar industry is so connected with their general welfare, that whatever affects either affects both. For this reason, questions of importance to them, not directly connected with the sugar trade, may from time to time be discussed in the columns of "The Sugar Cane," but, as it is intended to represent the sugar interest in all parts of the world where British industry and British capital are concerned, anything narrow or partial will necessarily be excluded.

The conductors of "The Sugar Cane" will give their subscribers good value, even in mere letter-press; but the magazine cannot maintain the position which it is intended to occupy, unless it is taken by a large proportion of those whose interests it is designed to advocate. For though the geographical area over which it will circulate is wide, the number of its readers will necessarily be small in proportion to the "general public," to whom magazines and other periodicals without any speciality, are addressed. It is therefore hoped, that every one who receives the first number, and finds it of value to him, will not only subscribe at once, if he has not already done so, but will try to induce his friends to follow his example. As only a definite number of copies will be struck off, subscribers should send in their names at once, before the early numbers are out of print.

ANALYSIS OF CANE SOILS FROM ANTIGUA,

By R. Angus Smith, Ph. D., F.R.S., &c.

The amount of the several constituents in these soils from Antigua does not seem to suggest any idea of great fertility. However, it is to be feared that our knowledge of soil is still too limited to enable us to judge from analysis alone.

Let us compare them with good soils, such as Dr. Anderson gives as specimens of the best from the Lothians and Carse of Gowrie, called A and B.

The amount of organic matter is rather small. It varies from 4 to about 6 per cent. In A the amount rises to 9. The Antigua soils were dried at 110° C as will be seen, and it is possible that some oxidation may have occurred on the way; a little certainly. The Nitrogen is small in all of them. In A it rises to 0·221. We may imagine some to have gone off as Ammonia, but it is more probable that the soil there really does get rid of its organic matter quickly, on account of the rapid action of the air and the general activity of all the operations connected with vegetation in a hot climate. If this be so, we are able to see why Malaria should rise in a hot climate when no peculiar products are produced. The cause may simply be the more rapid production of those that are formed in all or most soils.

The Nitric Acid is small in amount, and if the Nitrogen is carried off as supposed, we see the reason. A practical conclusion from this is that the vegetable manure to be used by the plant as food will be destroyed rapidly, and the time of planting must coincide with that of dressing, if the dressing with manure ought not rather in all cases to take place when the plant is in the ground. At any rate it will be well to remember that volatile and organic manure will not keep well, and especially in the ground it will become rapidly useless.

The absorptive power of the soil is considerable especially taking into account the want of organic matter. This is probably owing to the large amount of Alumina. This substance is especially to be found in the soluble parts of Nos. 1—5 inclusive. Much less in 8. Still we cannot find the connection in all its details. The amount of Chlorides probably accounts for the absorption to a great extent. All the soils are acid; it is a proof of active oxidation, but it is almost constantly the case that soils are acid; we are not acquainted with the contrary condition well. On the heaths of Lancashire I have found the soil alkaline in warm weather, and giving out a considerable amount of humate of ammonia to the brown water, whilst on the first approach of winter acidity began. So also in the rich soil of hothouses I have found alkaline soil, but the true relations of this to fertility are not known. There seems to be a struggle against it in this country. We therefore require so much lime. It may be that the oxidation with us is not sufficient, it produces oxides soluble in water forming organic acids, but in warmer climates the oxidation goes on till carbonic acid is formed. For this reason these soils of Antigua do not retain much organic matter or humus, whereas in our colder climate we are apt to collect material in the shape of peat. Peat does not grow in a climate which oxidises its organic matter up to the utmost pitch so as to form carbonic acid.

The water actually retained by the soil when spontaneous evaporation had taken place to its utmost is very large, and this retentiveness of water seems to be one of the peculiarities of these soils.

Continuing to compare with A and B. The amount of Potash is low in all these soils. The amount of Soda on the other hand is high, both in the portion soluble in water and the that soluble in acids. There is a considerable amount of Potash in the part insoluble in acids, but the larger amount of Soda in the other portions suggests the influence of the sea, the spray from which is without doubt blown over the island.

This is shown also in the larger amount of Chlorine which is found in the portion soluble in water. I do not know if the more or less proximity to the sea would account for the differences of the specimens.

Sulphuric Acid is evidently in considerable quantity, and does not require to be supplied. The existence of Sulphate of Lime or Alkali will no doubt account for some of the retained water, but there is not sufficient to account for all or even a major part of it.

Magnesia exists in fair amount in that soluble in water and there is still more in the quantity dissolved by acids.

Lime seems to be abundant in all the divisions.

Phosphoric Acid is low in all; Nos. 8 and 9 have most.

Alumina in a very soluble state is very high, and that seems to be a distinguishing property of these soils. It shows a condition in which the cohesion is not so powerful as to prevent useful chemical or absorptive action, and when the Alumina is dissolved the Potash will, no doubt, be dissolved with it if felspar gives the supply. It is true we do not find a great deal dissolved, but we find the rest easily decomposed so that the solution takes place readily, which is a very important point.

The three substances most frequently present in rich soils, Phosphoric Acid, Potash and Nitrogen do not appear here in great quantity.

Dr. Anderson gives the analysis of a soil from Antigua in which there is more Potash in the soluble part than is found here, but then there is less in the part insoluble in acids.

On the whole these soils seem from their physical condition to be excellent, but to be considerably exhausted of their valuable chemical constituents. Lime or manuring is needful. We cannot tell if Soda will replace to a large extent Potash in the sugar cane, if so the Soda is here, if not the Potash must be supplied artificially.

It will be extremely interesting to see which of these soils bring the most valuable crops. In the present condition of our knowledge of soil I fear we could not speak confidently.

When we examine the analysis of the ash of the cane we find where the Potash and Phosphoric acid have gone. Dr. Stenhonse did good service by saying that the ash ought to be returned. These elements at least cannot be supplied to the cane unless the soil receives them back. Of the other firefast bodies there seems to be enough.

SOILS.

	No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.	No. 7.	No. 8.	No. 9.
Moisture	15·37	14·96	9·81	11·11	13·29	19·50	24·00	15·08	20·35
Nitrogen	0·029	0·0525	0·0625	0·067	0·054	0·065	0·033	0·0785	0·085
Moisture absorbed by the dried soil	4·36	4·28	4·01	5·23	3·37	4·54	4·26	4·40	4·37
Nitric Acid	a little	a little	a little	trace	trace	distinct	no	a little	distinct
Acidity	acid	acid	very acid	acid	acid	acid	acid	acid	slightly acid

---

SOIL No. 1.

Dried at 110° C 100 parts by weight contain—

	Organic matter and volatile			4·6400
Soluble in water 0·1249	Sulphuric acid	SO_3 ..	0·03089	
	Chlorine ..	Cl	0·01440	
	Lime	CaO	0·05012	
	Magnesia ..	MgO ..	0·01716	
	Soda	NaO ..	0·01235	
	Potash ..	KO		.. 0·1249

Soluble in Hydrochloric acid 12·1413	Carbonic acid	CO_2	0·05000	
	Silica	SiO_3	0·61330	
	Sulphuric acid	SO_3	trace	
	Phosphoric acid	PO_5	0·00876	
	Lime	CaO	0·91980	
	Magnesia	MgO	0·08278	
	Alumina	Al_2O_3	6·56150	
	Peroxide of Iron	Fe_2O_3	3·69720	
	Soda	NaO	0·20235	
	Potash	KO	0·00569	12·1413
Rendered soluble by concentrated Sulphuric acid 8·5900	Lime	CaO	0·36512	
	Magnesia	MgO	0·25409	
	Peroxide of Iron	Fe_2O_3	1·75627	
	Alumina	Al_2O_3	6·12238	
	Soda	NaO	0·07194	
	Potash	KO	0·02025	8·5900
Insoluble in acids 74.504	Silica	SiO_3	55·50548	
	Alumina	Al_2O_3	15·64584	
	Potash	KO	3·05466	
	Soda	NaO	0·29802	74·5040
				100·504

SOIL No. 2.

Dried at 110° C 100 parts by weight contain—

	Organic matter and volatile			3·7500
Soluble in water 1.5067	Sulphuric acid	SO_3	0·33400	
	Chlorine	Cl	0·21603	
	Lime	CaO	0·61288	
	Magnesia	MgO	0·15495	
	Soda	NaO	0·18884	
	Potash	KO		1·5067
Soluble in Hydrochloric acid 12.4279	Carbonic acid	CO_2	1·17670	
	Silica	SiO_3	0·08876	
	Sulphuric acid	SO_3	0·08432	
	Lime	CaO	0·62671	
	Magnesia	MgO	0·06816	
	Alumina	Al_2O_3	5·00352	
	Peroxide of Iron	Fe_2O_3	5·31640	
	Phosphoric acid	Po_5	Trace	
	Potash	KO		
	Soda	NaO	0.06640	12·4279
Rendered soluble by concentrated Sulphuric acid 9.8136	Lime	CaO	0·23038	
	Magnesia	MgO	0·05386	
	Alumina	Al_2O_3	7·46545	
	Peroxide of Iron	Fe_2O_3	1·91930	
	Potash	KO	0·03980	
	Soda	NaO	0·10488	9·8136

Insoluble in acids 72.5016	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		72·5016
				100·00

SOIL No. 3.

Dried at 110°C, 100 parts by weight contain—

	Organic matter and volatile			5·1000
Soluble in water 2·6821	Sulphuric acid	So_3	0·59958	
	Chlorine	Cl	0·41891	
	Lime	CaO	1·13312	
	Magnesia	MgO	0·17163	
	Soda	NaO	0·35008	
	Potash	KO	0·00885	2·6821
Soluble in Hydrochloric acid 11·5547	Carbonic acid	Co_2	0·05118	
	Silica	SiO_3	0·12714	
	Sulphuric acid	SO_3	0·05607	
	Lime	CaO	0·61711	
	Magnesia	MgO	0·13789	
	Alumina	Al_2O_3	5·21644	
	Peroxide of Iron	Fe_2O_3	5·37900	
	Phosphoric acid	Po_5	Trace	
	Soda	NaO	0·04058	
	Potash	KO	0·02934	11·5547
Rendered Soluble by concentrated Sulphuric acid 10·6503	Lime	CaO	0·86559	
	Magnesia	MgO	0·08528	
	Alumina	Al_2O_3	6·06127	
	Peroxide of Iron	Fe_2O_3	2·51043	
	Soda	NaO	1·02869	
	Potash	KO	0·09913	10·6503
Insoluble in acids 70·0126	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		70·0126
				100·00

SOIL No. 4.

Dried at 110°C, 100 parts by weight contain—

	Organic matter and volatile			5·4900
Soluble in water 1·4261	Sulphuric acid	So_3	0·40882	
	Chlorine	Cl	0·20946	
	Lime	CaO	0·55837	
	Magnesia	MgO	0·15495	
	Soda	NaO	0·09039	
	Potash	KO	0·00412	1·4261

Soluble in Hydrochloric acid 14·5037	Carbonic acid	Co_2	0·12960	
	Silica	SiO_3	0·64800	
	Sulphuric acid	So_3		
	Lime	CaO	1·89500	
	Magnesia	MgO	0·04320	
	Alumina	Al_2O_3	7·49400	
	Peroxide of Iron	Fe_2O_3	4·16380	
	Phosphoric acid	Po_5	0·00504	
	Potash	KO	0·04040	
	Soda	NaO	0·08468	14·5037
Rendered soluble by concentrated Sulphuric acid 12.4110	Lime	CaO	0.38800	
	Magnesia	MgO	0.10800	
	Alumina	Al_2O_3	8.96000	
	Peroxide of Iron	Fe_2O_3	2.60000	
	Potash	KO	0.07100	
	Soda	NaO	0.28400	12.4110
Insoluble in acids 66.1691	Silica	SiO_3	50.71140	
	Alumina	Al_2O_3	11.21422	
	Potash	KO	3.12100	
	Soda	NaO	1.12355	66.1691
				100.00

SOIL No. 5.

Dried at 100°C, 100 parts by weight contain—

	Organic matter and volatile			5.3900
Soluble in water 3.2889	Sulphuric acid	SO_3	0.89303	
	Chlorine	Cl	0.51275	
	Lime	CaO	1.25297	
	Magnesia	MgO	0.21168	
	Soda	NaO	0.41354	
	Potash	KO	0.00494	3.2889
Soluble in Hydrochloric acid 11.0724	Carbonic acid	CO_2	0.04365	
	Silica	SiO_3	0.14344	
	Sulphuric acid	SO_3	0.05036	
	Lime	CaO	1.32430	
	Magnesia	MgO	0.04215	
	Alumina	Al_2O_3	4.89000	
	Peroxide of Iron	Fe_2O_3	4.46981	
	Phosphoric acid	Po_5	0.00782	
	Potash	KO	0.02099	
	Soda	NaO	0.07993	11.0724
Rendered soluble by concentrated Sulphuric acid 11.5098	Lime	CaO	0.44144	
	Magnesia	MgO	0.14992	
	Alumina	Al_2O_3	8.09920	
	Peroxide of Iron	Fe_2O_3	2.73280	
	Soda	NaO	0.07288	
	Potash	KO	0.01360	11.5098

Insoluble in acids 68.7388	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		68.7388
				100.00

SOIL No. 6.

Dried at 110°C, 100 parts by weight contain—

	Organic matter and volatile			4.66
Soluble in water 0.8475	Sulphuric acid	SO_3	0.09084	
	Chlorine	Cl	0.11783	
	Lime	CaO	0.39224	
	Magnesia	MgO	0.15257	
	Soda	NaO	0.09408	
	Potash	KO		0.8475
Soluble in Hydrochloric acid 5.6738	Carbonic acid	CO_2	0.39376	
	Silica	SiO_3	0.16511	
	Sulphuric acid	SO_3	0.03700	
	Lime	CaO	0.86204	
	Magnesia	MgO	0.01623	
	Alumina	Al_2O_3	2.60748	
	Peroxide of Iron	Fe_2O_3	1.53010	
	Phosphoric acid	Po_5	0.00961	
	Potash	KO	0.01632	
	Soda	NaO	0.03624	5.6738
Rendered soluble by concentrated Sulphuric acid 12.5037	Lime	CaO	0.34912	
	Magnesia	MgO	0.04800	
	Alumina	Al_2O_3	8.35680	
	Peroxide of Iron	Fe_2O_3	3.72320	
	Soda	NaO	0.01928	
	Potash	KO	0.00736	12.5037
Insoluble in acids 76.3147	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		76.3147
				100.00

SOIL No. 7.

Dried at 100°C, 100 parts by weight contain—

	Organic matter and volatile			4.1300
Soluble in water 1.7013	Sulphuric acid	SO_3	0.47694	
	Chlorine	Cl	0.30273	
	Lime	CaO	0.61288	
	Magnesia	MgO	0.05363	
	Soda	NaO	0.25320	
	Potash	KO	0.00198	1.7013

Soluble in Hydrochloric acid 7.4438	Carbonic acid	CO_2	0.19950	
	Silica	SiO_3	0.13690	
	Sulphuric acid	SO_3	0.04381	
	Lime	CaO	1.45484	
	Magnesia	MgO	0.09343	
	Alumina	Al_2O_3	3.25711	
	Peroxide of Iron	Fe_2O_3	2.21519	
	Phosphoric acid	PO_5	0.00592	
	Potash	KO		
	Soda	NaO	0.03618	7.4438
Rendered soluble by concentrated Sulphuric acid 8.8568	Lime	CaO	0.37492	
	Magnesia	MgO	0.09828	
	Alumina	Al_2O_3	6.88870	
	Peroxide of Iron	Fe_2O_3	1.42030	
	Potash	KO	0.00728	
	Soda	NaO	0.06734	8.8568
Insoluble in acids 77.8676	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		77.8676
				100.00

SOIL No. 8.

Dried at 100°C 100 parts by weight contain—

	Organic matter and volatile			4·9600
Soluble in water 1·2717	Sulphuric acid	SO_3	0·30507	
	Chlorine	Cl	0·22253	
	Lime	CaO	0·45426	
	Magnesia	MgO	0·19070	
	Soda	NaO	0·09915	
	Potash	KO		1·2717
Soluble in Hydrochloric acid 11·0398	Carbonic acid	CO_2	2·70413	
	Silica	SiO_3	0·35061	
	Sulphuric acid	SO_3	0·20553	
	Lime	CaO	4·12269	
	Magnesia	MgO	0·29036	
	Alumina	Al_2O_3	1·84372	
	Peroxide of Iron	Fe_2O_3	1·17792	
	Phosphoric acid	PO_5	0·01640	
	Potash	KO	0·03802	
	Soda	NaO	0·09050	11·0398

Rendered soluble by concentrated Sulphuric acid 19·3921	Lime	CaO	0·38960	
	Magnesia	MgO	0·90304	
	Alumina	Al_2O_3	13·93238	
	Peroxide of Iron	Fe_2O_3	4·11182	
	Potash	KO	0·00838	
	Soda	NaO	0·04697	19·3921
Insoluble in acids 63·3362	Silica	SiO_3		
	Alumina	Al_2O_3		
	Potash	KO		
	Soda	NaO		63·3362
				100·00

SOIL No. 9.

Dried at 110° C, 100 parts by weight contain—

	Organic matter and volatile			6·4200
Soluble in water 1·0895	Sulphuric acid	SO_3	0·181700	
	Chlorine	Cl	0·086974	
	Lime	CaO	0·675471	
	Magnesia	MgO	0·076057	
	Soda	NaO	0·069328	
	Potash	KO		1·0895
Soluble in Hydrochloric acid 13·5916	Carbonic acid	CO_2	2·69013	
	Silica	SiO_3	0·26100	
	Sulphuric acid	SO_3	0·07263	
	Lime	CaO	4·59000	
	Magnesia	MgO	0·04860	
	Alumina	Al_2O_3	3·75225	
	Peroxide of Iron	Fe_2O_3	2·00715	
	Phosphoric acid	PO_5	0·04236	
	Potash	KO	0·03765	
	Soda	NaO	0·08991	13·5916
Rendered soluble by concentrated Sulphuric acid 24·6150	Lime	CaO	0·18958	
	Magnesia	MgO	0·47840	
	Alumina	Al_2O_3	17·97790	
	Peroxide of Iron	Fe_2O_3	5·48209	
	Potash	KO	0·05961	
	Soda	NaO	0·42752	24·6150
Insoluble in acids 45·7162	Silica	SiO_3	33·04100	
	Alumina	Al_2O_3	11·25210	
	Potash	KO	1·04000	
	Soda	NaO	0·38315	45·7162
				100·00

THE FIELD EXPERIMENTS OF W. B. LAWES, Esq.,

AT ROTHAMSTEAD, HERTS,

WITH AN INTRODUCTION, BY R. ANGUS SMITH, PH. D., F.R.S., &c.

ALTHOUGH these experiments, annually made for a series of years, and therefore invaluable to the English agriculturist, do not bear directly on the question of sugar cultivation, yet I regard them as important, even to the grower of cane, (which is in reality a species of grass;) and he may learn as much from their study as from any matter extant. It is to be hoped that the planters in various parts will make them a model for similar experiments on the growth of the cane. It is very interesting to observe the effect of manures on the various kinds of grass. These are not stimulated equally, but one grass becomes prominent with one manure and another by another. These experiments bring out into prominence the necessity of learning more carefully than ever the peculiar food and stimulus of every plant, and thus completely prevent all certainty, or at least dogmatism, as to the result of any untried manure. Experiments such as are now in course at Mr. Lawes' farm are better suited to guide us than any theoretical opinions. This is somewhat humiliating, but we must not expect to comprehend the secret activities of plants after a few experiments only. The wonderful impetus to inquiry given in this direction by the genius of Liebig is leading us not only to learn more in old fields, but to new regions where more is to be learnt. His eminent successors at Harpenden have done, and are doing, their work on a scale scarcely ever equalled by private individuals; and in the department of agriculture their establishment has become a great national institution in every sense but this—that it is supported by a private purse. It is possible that the analysis of soil may, in the eyes of men so experienced as Messrs. Lawes and Gilbert, show much of its character. I am obliged, however, to confess that it does not to me show much. All must agree that we should learn from experiments undertaken after the manner of those at Rothamstead, of which the following table will show some of the results.

EXPERIMENTS WITH DIFFERENT MANURES ON PERMANENT MEADOW LAND.—THE PARK.

The land has probably been laid down with Grass for some centuries. No fresh seed has been artificially sown within the last 30 years certainly; nor is there record of any having been sown since the Grass was first laid down. The experiments commenced in 1856, at which time the character of the herbage appeared uniform over all the Plots. Excepting as explained in the Table, and in the footnotes, the same description of Manure has been applied year after year to the same Plot.

[Area under experiment, about 6¾ acres.]

1 acre .... = (about) 0·40 Hectare................ or 1·59 Prussian Morgen.
1 lb. (pound avoir.).... = (about) 0·45 Kilogramme .... or 0·91 Zollverein Pfund.
1 cwt. (hundredweight) = (about) 51·0 Kilogrammes .... or 1·02 Centner.
1 ton .... = (about) 1016·0 Kilogrammes .... or 20·33 Centner.
1 lb. per acre.......... = (about) 1·12 Kilogramme per Hectare or 0·57 Zollv. Pfd. per Pr. Morgen.
1 cwt. per acre........ = (about) 125·5 Kilogrammes per Hectare or 0·64 Centner per. Pr. Morgen.

PLOTS.	Manures, per acre; fourteenth season—1869.	Produce per Acre, weighed as Hay. Average per Annum; 13 Years 1856—1868.	Produce per Acre, weighed as Hay. Thirteenth Season; 1868.
		Cwts.	Cwts.
1	200 lbs. Ammonia salts [1] [also, for the first 8 years, 1856—1863, 14 tons Farmyard Manure per acre per annum.]	47¾	41¾
2	Unmanured, 1864 and since [for the first 8 years, 1856—1863, 14 tons Farmyard Manure per acre per annum]	42	36¾
3	Unmanured, continuously	22¾	17¼
4 a	Superphosphate of Lime [2]	24¾ [9]	19¾
4 b	" ; and 400 lbs. "Ammonia-salts"	38 [9]	29¼
5	400 lbs. "Ammonia-salts"	29½	24
[3] 6	Sulphates of Potass, Soda, and Magnesia [4]; and "Superphosphate of Lime" (previously, 1856—1868 inclusive, Ammonia-salts as Plot 5)	30½	27½
7	Sulphates of Potass, Soda, and Magnesia [4]; and "Superphosphate of Lime"	35	38
[3] 8	Sulphates of Soda and Magnesia [5]; ditto	32¾	27¼
9	Sulphates of Potass, Soda, and Magnesia [4]; ditto; and 400 lbs. "Ammonia-salts"	52¾	59¼
10	Sulphates of Soda and Magnesia [5]; ditto; 400 lbs. "Ammonia-salts"	50¾	44¼
11	Sulphates of Potass, Soda, and Magnesia [4]; ditto; 800 lbs. [6] "Ammonia-salts"	61½	63¾
11a	Sulphates of Potass, Soda, and Magnesia [4]; and "Superphosphate of Lime;" 800lbs. [6] "Ammonia-salts; and 200 lbs each, Silicate of Soda and Silicate of Lime [7]	64½	72¼
12	Unmanured, continuously	25¼	24
13	Sulphates of Potass, Soda, and Magnesia [4]; "Superphosphate of Lime; 400 lbs. Ammonia-salts;" and 2000 lbs. Cut Wheat-straw	53	55½
14	Sulphates of Potass, Soda, and Magnesia [4]; "Superphosphate of Lime;" and 550 lbs. Nitrate of Soda [8]	56 [10]	69
15	none; none; 550 lbs. ditto	37 [10]	32
16	Sulphates of Potass, Soda, and Magnesia [4]; "Superphosphate of Lime;" and 275 lbs. ditto	47 [10]	51¼
17	none; none; 275 lbs. ditto	35 [10]	29
18	Mixture supplying the quantity of Potass, Soda, Lime, Magnesia, Phosphoric Acid, Silica, and Nitrogen contained in 1 ton of hay (commencing in 1865)	32¾ [11]	27½

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[1] Equal parts Sulphate and Muriate of Ammonia of Commerce.

[2] 200 lbs Bone-ash, 150 lbs. Sulphuric Acid [Sp. gr. 1·7].

[3] Plots 6, 8, and 10, had, besides the Manures specified, 2000 lbs. Sawdust per acre per annum for the first seven years, 1856—1862, but without effect.

[4] 300 lbs. Sulphate of Potass, 100 lbs. Sulphate of Soda [200 lbs. 1856—1863], and 100 lbs. Sulphate of Magnesia.

[5] 250 lbs. Sulphate of Soda [500 lbs. in 1862 and 1863], and 100 lbs. Sulphate of Magnesia [Sulphate of Potass also, as on Plots 7, &c., 1856—1861].

[6] 800 lbs. in 1856-7-8; only 400 lbs. in 1859-60-61; and 800 lbs. since.

[7] The application of Silicates did not commence until 1862.

[8] 550 lbs. Nitrate of Soda is reckoned to contain the same amount of Nitrogen as 400 lbs. of "Ammonia-salts."

[9] Average of 10 years only, as the manures specified were first applied in 1859 [previously, 1856—1868 inclusive, Sawdust only].

[10] Average of 11 years only, as these experiments did not commence until 1858.

[11] Average of 4 years only, as the experiment only commenced in 1865.

ON BEET MOLASSES.

By Dr. Wallace, Glasgow.

The molasses, or treacle, obtained in the manufacture of sugar from beet root, is not directly interesting to the British sugar refiner, since it is never imported into this country, and is used almost exclusively in the production of a coarse spirit by fermentation. But the beet sugars used by us for refining purposes may be regarded as mixtures of pure cane sugar with beet molasses, the proportion of the latter varying from 10 to 30 per cent., according to quality; and, therefore, the study of the composition of beet molasses is of great importance to those refiners who are in the habit of mixing beet with West India or other descriptions of cane sugar.

Beet molasses differs very widely from that prepared from cane juice. Both contain a large quantity of cane sugar, which is rendered uncrystallizable by the presence of certain impurities. In ordinary West India molasses, or rather in treacle, the ingredient which prevents the crystallization and extraction of the cane sugar is itself a variety of saccharine matter, usually known as fructose, or fruit sugar, and sometimes, although improperly, grape sugar. The following average analyses of molasses, treacle, and golden syrup, show the influence of fructose in preventing the crystallization of cane sugar. In the two latter, all the cane sugar that can be extracted has been removed.

	W. I. Molasses.	Treacle.	Golden Syrup
Cane sugar	47·0	32·5	39·0
Fruit sugar	20·4	37·2	33·0
Extractive & colouring matter	2·7	3·5	2·8
Salts	2·6	3·4	2·5
Water	27·3	23·4	22·7
	100·0	100·0	100·0
Specific Gravity	1·360	1·430	1·415

I have shown elsewhere that when a syrup contains less than 8 parts of cane sugar to 10 of grape sugar it becomes undrainable at any temperature, and hence there is a distinct limit, as our refiners well know, to the extraction of cane sugar from syrups.

Beet molasses is also in the condition of containing a large proportion of cane sugar which is not capable of being extracted by ordinary means, but the preventive agency in this case is not fructose but alkaline salts, chiefly combined with organic acids. There can be no doubt that the molasses will vary much in composition according to the district in which the beets have been grown, as well as the mode of manufacture. The following analysis of French molasses must therefore be regarded simply as that of a particular sample, and not as an average of all the varieties.

BEET MOLASSES.*

Cane Sugar	46·7
Fruit Sugar	·6
Organic Acids, Extractive and Gummy Matter, &c.	15·8
Alkaline Salts	13·2
Water	23·7
	100·0
Specific Gravity	1·405

Among the mineral salts in beet molasses, and in low beet sugars, potassic nitrate is occasionally present; sometimes, in low sugars, in such proportions as to be readily recognizable by the taste and by the ordinary chemical tests. In the above sample of molasses, I have not been able, satisfactorily, to prove the presence of nitrates, and if these are present at all, the proportion must be small. A sensible amount of nitrogen was found, but it appeared to exist chiefly, if not entirely, in the form of an organic compound.

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* In a paper read before the Philosophical Society of Glasgow, and published in the *Chemical News* of 18th December, 1868, a sample of beet molasses is mentioned as containing 60 per cent. of cane sugar, and 3 per cent of organic matters. These numbers should have been 50 and 13 respectively, and have been so corrected in the proceedings of the Philosophical Society.

The molasses was distinctly alkaline, the alkalinity being represented by ·45 per cent. of free soda, but after burning away the organic matter the alkalinity was increased ten-fold, evidently from the conversion into carbonates of salts of potassium and sodium with organic acids.

M. F. Margueritte† states that beet molasses contains a great variety of organic acids besides other organic compounds, and he has published a process for the extraction of a large proportion of the sugar by treating with alcohol and sulphuric acid, for an account of which I refer to his paper.

A quantity of the salts from beet molasses was prepared by evaporating and charring a considerable quantity, extracting the salts with water, and boiling down to dryness. Analysis gave as follows:—

SALTS FROM BEET MOLASSES.

Potassic Chloride	18·70
Potassic Sulphate (Sulphate of Potash)	4·18
Potassic Carbonate (Carbonate of Potash)	53·80
Sodic Carbonate (Carbonate of Soda)	20·81
Calcic Carbonate (Carbonate of Lime)	·35
Magnesia	·27
Moisture and loss	1·89
	100·00

From these results it will be observed that the salts consist in great part of alkaline carbonates. In France, large quantities of potassic carbonate and other salts are obtained from beet molasses by fermenting, distilling off the spirit, evaporating the spent wash, charring, and extracting the salts, which are afterwards separated by taking advantage of their different degrees of solubility.

When beet sugars are used in the refinery, and especially under the Greenock system of turning out no syrup, the salts frequently accumulate in the liquors to an alarming extent, and render the system referred to a far from profitable one. Under such circumstances the syrup drained by the centrifugal machines from the low "yellows" occasionally contains from 4 to 5 per cent. of alkaline salts, and if we accept the French calculation, which is, I believe, not far from the truth, that every per cent. of these salts prevents the crystallization of 5 per cent. of cane sugar, we can readily understand how it is that the working of these syrups is often very unsatisfactory. It is true that beet sugars contain a mere trace of fructose, but they introduce into the syrups an ingredient which is in some respects even more objectionable. The proportion of alkaline salts in beet sugars, such as are used by refiners in this country, varies from 1 to 4 per cent., and in extreme cases a larger quantity has been observed. Refiners would do well to reject all beet sugars that contain more than from 1½ to 2 per cent of salts. The continued use of inferior beet sugars is certain to end in disappointment and loss.

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† *Chemical News*, 23rd April, 1869, (translated from *Comptes Rendus*).

RESEARCHES ON THE JUICE OF THE SUGAR CANE,

AND ON THE MODIFICATIONS TO WHICH IT IS SUBJECT DURING MANUFACTURE, IN THE ISLAND OF MAURITIUS.

From the French of Dr. Icery.[*]

INTRODUCTION.

DURING the last two years I have taken particular notice of the different modifications to which the juice of the cane is subject during the process of manufacture, as carried on in this Colony, and have been led insensibly to extend my studies to the plant itself, and to consider, step by step, all the questions which relate to its history. I now propose in a brief resumé to embody the notes I have collected on those points, which deserve the planters' most particular attention. But before presenting the results of these observations, a few words on the earliest developments of the sugar industry will not be out of place.

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[*] Paris: Challamel Aîné, Rue des Boulangers-Saint-Victor, 30.

The sugar cane is a native of those parts of Asia now known as India, and Indo-China, where it was exclusively cultivated from remote antiquity until towards the middle of the thirteenth century, at which period the merchants by whom the sugar trade was carried on, began to penetrate into the countries beyond the Ganges, whence they brought the precious plant, which was soon propagated in Arabia, Syria, and Egypt. At the end of the following century it was introduced into Cyprus and Sicily, and thence into Madeira and the Canary Islands, and before very long it became in Spain, and even as far north as the middle of France, a favourite object of culture.

Imported into St. Thomas and St. Domingo in the beginning of the 16th century, its culture was there so rapidly developed, that in a few years a considerable number of sugar plantations were established in those Colonies.

It was nearly two centuries and a half after, that is to say, about 1750, that the sugar cane was first introduced into the Mauritius. Its cultivation, at first confined to a few estates, and undertaken on a limited scale, made but little progress, and continued for a long time almost stationary. But about 60 years later, the cane becoming better appreciated, made a fresh start, and was gradually substituted for most of the crops formerly cultivated, and at present it constitutes the most sure and effective resource of all the large estates in the Island.

It is generally thought that the cane first planted in this Colony, is that commonly called "the White Cane," which is indigenous to the islands of the Pacific. This variety, one of the most juicy and saccharine known, has formed for a long time the greater part of the plantations of the Mauritius; but the disease with which it was attacked about 20 years ago, has considerably restricted its use.

Many varieties of cane have been since introduced into the Island, cultivated and propagated with care, but not all with equal success. The most productive, having been constantly renewed, are those which are now threatened with the deterioration from which certain estates have already suffered so much loss.

Of twenty varieties which have been introduced at different periods, we will take six of the most common which have been exclusively the object of our experiments.—

1.—The White Cane of Otaheite.
2.—The Bamboo, or Cane of Batavia.
3.—The Guinghan, or Violet Striped Cane.
4.—The Bellognet, or Purple Java Cane.
5.—The Penang Cane.
6.—The Diard Cane, with which the White Bellognet is generally confounded.

Before the cultivation of the cane had reached the extent it has acquired of late years, ere it had become the chief resource of the colony, it increased with marvellous rapidity, and that without the aid of manure. Above the rich and virgin soil into which its roots penetrated deeply, the canes grew in layers of thick matted stalks, five or six feet high.

But the imperfect processes of manufacture prevented the planters reaping all the benefit from this luxuriant vegetation. The method of extracting the juice was most in fault, being simply that copied from the Arabs, with scarcely any improvement, until the end of last century, and which did not in fact undergo any amelioration until steam machinery and the Vacuum apparatus enabled the planter to obtain nearly the same quality of sugar in whatever soil or climate the cane had been grown. We know, for instance, that for a long time planters near the coast could easily manufacture a fine looking sugar, owing to advantages of climate and other causes, whilst those whose estates were in the high and moist parts of the interior could never succeed in manufacturing either the same quality, or equal quantity of sugar.

In the course of this essay will be seen, the causes which lead to such marked differences of production, and which have not hitherto been explained.

The advantages which we have derived from improved methods of manufacture have been in some degree neutralized by the too common practice of cultivating for a considerable period, the same crop on the same soil.

I do not desire here to enter on this question which is of too great importance to be mentioned in a casual manner, but I wish to draw attention to a fact which must be closely connected with some modifications attributed to the cane juice. I shall indeed have much further to seek if the deteriorations and diseases to which the cane is subject, operate equally on all the substances which enter into the composition of its juice.

The colonial sugar industry has again and again been reproached with adhering to blind practice, and with disdaining those improvements which science would not delay to introduce into its manufacture, if the planters, less prejudiced in favour of old customs, were anxious to acquire more perfect knowledge of their staple culture, and to profit by the example of a rival industry in Europe, whose intelligent enterprise has been so successful.

For the most part these reproaches are unjust, and can only prove an imperfect knowledge of the practice of the colonists. Assuming it to be correctly asserted that thirty years ago more than two-thirds of the sugar contained in the cane were lost by the methods of extraction, it may at least be said that now more than six-tenths are obtained by the machines at present in use, thanks to the progress realised in many instances at least, through native enterprise. Such progress is chiefly the result of improvements in the evaporating apparatus now in use on nearly every estate of importance on the island.

The process, which particularly includes the needful care of the juice during evaporation, has unfortunately not received all the improvement of which it is susceptible, but remains about the same as it was fifty years ago, notwithstanding all the experiments of which it has been the object, and which have failed through want of consideration of the chief obstacles in the way of success. If, consequently upon the making of analysis in unfavourable conditions, there was an exaggerated estimate of the importance of those substances which, combined with the sugar, form the juice of the cane; to compensate for it there has been latterly too great neglect of the part played by these substances in the manufacture of sugar. The prevailing scientific idea at the present day of the nature of cane juice, that it is nearly pure saccharine and water, should not, we think, be accepted any longer without limitation. In special circumstances, shortly to be explained, the juice in its natural state presents certain modifications, which must be considered if we would thoroughly understand the different results often obtained by the same processes of manufacture. The very simple nature attributed to the cane juice is not only contrary to the daily practice of sugar manufactories, it is also opposed to an attentive and continued study of the cane at different periods of its growth.

Thence arise the difficulties and obstacles in the manufacture of sugar which have been attributed to the inexperience of the planter and to his predeliction for the path of routine.

Chance, that providence to all rising industries, has from the commencement of sugar enterprise revealed the chief conditions to which the cane juice was subjected during evaporation in order to the production of good sugar in sufficient quantity. Thus, whatever apparatus has been used, the old method is still adhered to, and will of necessity continue to be so long as we are legally prevented from the manufacture of refined sugar at the first essay by the use of animal charcoal.

In the present state of our market, and with all the conflicting eventualities which weigh so heavily on the industry of this colony, a complete reform is not to be realised. The colonists are not able, as the beet sugar makers, to determine before manufacture, the quality or sort which, with the proceeds at their disposal, would produce the greatest amount of profit. Limited in their action, and fettered by conditions unknown to European manufacturers, the colonial planters have to calculate not the greatest amount of sugar they can make of their juice, but the most remunerative price it will bring according to those recognised shades of difference which have no relation to the saccharine richness of their products. For, as I shall presently show, the first qualities cannot be obtained without sacrificing a far greater quantity of sugar than is generally supposed, which loss is more apparent in one condition of the juice, to which I shall draw attention before I conclude.

In the first place I shall consider the degree of pressure obtained, by an examination of the yield at the sugar mill, from th different species of canes, and estimate the influence on the qualities and composition of the juice by the pressure to which it is subjected.

I shall then specify the chief characteristics of the freshly pressed juice, and the peculiarities shown by microscopical examination, which are deserving of the future attention of the planter.

In the second part of this essay I shall examine the chemical properties of the cane juice, dwelling particularly on certain substances the properties of which have not perhaps hitherto been determined. In the third part I shall endeavour to determine the causes of the principal alteration to which the juice is subject during the process of evaporation as commonly practised in this colony.

PART 1ST.—EXTRACTION OF THE JUICE.

THE cause of the greater part of the loss long felt, in the manufacture of sugar in the Mauritius was, without doubt, the inefficiency of the machinery used in crushing the cane.

The mills first in use consisted of three upright rollers worked by mules. The first improvement on this system, rude as it was defective, was to employ the more regular action of wind or water power. Soon afterwards, steam was applied to cane mills, which were at the same time greatly improved in construction, and thus worked with power and precision before unknown. But these mills were still capable of great improvement; the irregularity and too great rapidity of movement, as well as the insufficient resistance of some parts of the machinery, did not permit of the application of sufficient pressure to yield more than 45 to 50 per cent. of juice to the weight of cane.

In recent times more perfect machinery with force equal to the resistance to be overcome, has inaugurated an era of real progress, and the yield of cane juice has increased about 25 per cent.

Numerous experiments have been made in other places to determine the quantity of juice which could on the average be extracted from the cane by the various mills in use. It seems to me to be interesting to repeat these experiments, as we cannot assign too great importance to the results obtained by this first part of the work of our machinery.

Under this head extraordinary differences might be produced, not only from the greater or less perfection of the machinery employed, but still more in the mode of using it, and the nature and age of the cane which is used.

To produce an adequate pressure in mills of large size, it is needful that the cylinders be constantly supplied with a considerable quantity of canes, and requires an amount of care not always easy of attainment. I have seen powerful mills of nominally 60 to 80 horse power produce no more effect than others three or four times less powerful, and yield in fact only 55 per cent. of the weight of canes. The return obtained, whatever the power, depends in great measure on the manner in which the pressure is exerted, and when this is not regularly applied, the more powerful mills lose the advantage they possess, of being able to crush daily a greater weight of cane.

Though we may be indisposed to admit, that mills otherwise perfectly regulated and aided by strong and expensive apparatus, do not always produce results superior to mills of far less power, yet every attentive observer who has visited the sugar manufactories of this Colony will allow that such *is* the fact; he will be astonished to see how little care is bestowed on this part of the work, and on examining the megass escaping from the cylinders he will frequently find it impregnated with juice equal to the half of what has been extracted from it. But we must say that in some establishments the pressure is always suited to the power of the machinery in use.

The general average of yield furnished by the best mills on the largest estates is about 75 per cent. of the juice contained in the cane, that is to say, three-fourths *of the liquid* is extracted; the quality of the canes, and the degree of resistance they offer, materially affect the proportion of juice yielded, which I have found to range between 84 and 69 per cent. of the juice.

The Bellognet, or Violet Cane of Java, is more easily crushed, and contains a greater proportion of juice than any other; after it comes the Diard Cane, the Cane of Otaheite, the Penang, the Guinghan, and the Bamboo.

The method employed to determine the yield of a cane mill is, first to weigh the canes to be crushed, then to estimate the juice obtained from them, or the weight of the megass remaining. This method entails considerable trouble in weighing because of the quantity of the substance used, and is not capable of the exactness which all experiments demand. Accordingly we find considerable difference of results in various authorities treating of the same subject.

I have adopted a much simpler method, which permits the undertaking of such researches without having to do with such considerable weights, and without taking account of the quantity of canes employed.

Having ascertained beforehand the per centage of ligneous matter contained in the cane to be tested, we take a certain quantity of megass wet from the mill, say about 250 grammes, taking care to select what represents the average result of the ordinary action of the rollers. This megass is then weighed and placed in a small bag of strong cloth so as to prevent all after loss, it is then rapidly washed in warm water, then completely dried in the stove, and the weight again ascertained; the difference between the two weights gives the quantity of juice remaining in the megass which had escaped being pressed by the mill.

Let $B =$ the weight of the damp megass;
$B' =$ „ „ dry megass;
$C =$ „ „ woody substance

contained in 100 parts of the canes passed through the mill, we shall then have $\frac{100\,B'}{C} - B = x$, or the quantity of the juice extracted corresponding to B of megass furnished by the mill. The quantity of canes corresponding to the weight B of megass is represented by $\frac{100\,B'}{C}$; thus the yield of any mill can be easily calculated by the plan of two successive weighings of a small quantity of the megass it produces. Strictly speaking, we need not determine the value of C by a special proof, this quantity varying very little, generally averaging 10 for the finest kinds of Bellognet and Diard, and 11·5 for the other kinds.

The following example will explain the operation clearly.

A mill of forty-horse power, acting on Guinghan canes, containing 11·5 per cent. of ligneous matter, produced megass of which a fair average sample weighed, when moist, 207·63 gr., and when dried, 87·30. Applying the above formula, we multiply 87·30 by 100; divide the product by 11·5, which gives 759·1; subtracting 207·63, we get 551·5. As the quotient 759·1 simply represents the equivalent of the quantity of canes before pressure, it is clear that we shall get the yield of the mill by the following proportion.

759·1 : 551·5 : : 1 : x = 72·6 per cent.

The absolute quantity of juice being 100—11·5, there has consequently been left in the megass 15·90 (*a*); thus for every 100 parts of juice contained in the Guinghan canes, about 82 parts have been extracted and 18 escaped the pressure of the mill.

We must next consider whether when increased pressure is used, we always extract the same quantity of sugar in proportion to the quantity of juice obtained; in other words, whether the *quality* of the juice is the same, and the elements of which it is composed are in the same proportion, whatever the pressure employed. It might happen, if the proportion was broken, that the advantage gained by increase of juice might be lessened by newly acquired properties which hindered subsequent processes and made the extraction of the sugar more difficult and costly.

This question which has never been studied deserves the most serious consideration. It is generally thought that the juice last extracted from the cane resembles that obtained by the first pressure, and this has never been doubted by those who in different

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	Grammes.		
(*a*) Juice extracted by the mill	551·5	= 72·6	per cent.
,, remaining in the megass ..	120·33	= 15·9	,,
Ligneous matter	87·3	= 11·5	,,
	759·13	100·0	,,

colonies have concerned themselves in increasing the compressive power of the cane mills. Some have even attributed greater saccharine richness to cane juice obtained by the last efforts of pressure. The researches which I have made have led me to a directly opposite opinion. Beyond a certain degree, the quantity of sugar obtained decreases in proportion to the increase of pressure, and that of other substances—as the principal nitrogenous matters and mineral salts, on the contrary, increase with the increased pressure.

The causes of these modifications are only to be found in the constitution of the plant, and the different degrees of resistance offered by its various parts. The medullary portions being in fact supplied with a more saccharine juice and offering less resistance to the pressure of the rollers, allow the juice to escape more freely, whilst the cortex and the outside tissues, less rich in sugar, retain more tenaciously the juices they possess.

The following results show the measure of the difference observable under these circumstances, the same whether the knots of the cane or the intervening parts are crushed.

A certain quantity of cane was subjected to a pressure equal to 60 per cent., and then to a second pressure of 78 per cent. The juice obtained by the first pressure was clear and thin, whilst that from the second pressure was thickened with a proportion of organic matter. After being carefully filtered they were analysed under precisely the same conditions.

	JUICE of White Bellognet Cane.		JUICE of Penang Cane.	
	1st Pres.	2nd Pres.	1st Pres.	2nd Pres.
Density	1084	1079	1080	1078
Quantity of Sugar per cent	19·8	18·9	19·6	18·5
Albuminous matters per cent	0·18	0·27	0·16	0·20
Weight of ashes per cent	0·20	0·22	0·13	0·23

The difference is more marked with the Penang cane than with the White Bellognet, on account of the former being harder and offering greater resistance to the pressure of the rollers.

With these results in view, it is easy to account for the discrepancies which occur in the sugar manufacture, and which have been variously explained. It is evident that juice extracted from the cane by slight pressure, being richer in saccharine and poorer in organic matters, is more easily worked, and produces a greater weight of sugar. This result is due less to the superior saccharine richness of the juice than to its containing less albuminous and saline matter, for by the usual mode of manufacture the process of evaporation cannot be prolonged without causing the inversion of a quantity of crystallisable sugar, and this is also subject in great measure to the quantity of organic matters contained by the juice.

It appears to me unquestionable that it is in the difference of the quality of the juice in proportion to the pressure to which the cane has been subjected that we must seek for a reasonable explanation of the general belief that with the *same means of evaporation* the manufacture of sugar was formerly easier than it is now. If we remember that the *first* progress realised was the introduction of more perfect mills, and that the evaporating machinery now in use was not adopted till long after, it will be difficult, without denying the results of experiments patent to all the world, not to attribute to the more forcible pressure of the cane what some have wrongly, I think, considered to result from its degeneracy. Further on, in continuing these researches, I shall show that this idea is contrary to the facts which present themselves daily to our notice, and shall then complete my remarks on the part which this assumed degeneracy of the cane exercises on the production of sugar.

PART II.—MICROSCOPICAL EXAMINATION.

Cane juice has at different periods been the object of numerous experiments. Chemistry has evolved the various substances of which it is composed, and has estimated more or less correctly their nature and relative value; it has also determined the modifications to which each is subject under the influence of the agents used in the manufacture of sugar, and has thus put the planter on his guard against the causes of alteration which he has to combat.

But if the chemical properties of the juice have been carefully considered, it is certain that its physiology has been completely neglected. Even the more recent writings on the subject contain nothing precise on this part of it. At first sight it does seem astonishing that after all the minute examinations which have been made of the structure of the plant it should be necessary to make new microscopic investigation of the juice, and that it is possible to deduce new facts worthy of notice.

But the juice is not only a liquid, holding a certain amount of mineral and organic substances in solution, but it contains organic matter appreciable by the microscope, and which is of so much importance as to demand the attention of the colonial sugar manufacturer and to call for special observation on my part. It is not my object to investigate the nature of this substance, and its functions in the nutrition of the cane and the formation of the saccharine, I only desire to bring to light important facts, and to point out the consequences daily resulting therefrom during the process of sugar manufacture.

However the juice may be extracted, whether by press or mill, it always contains a proportion of tissue and residuum of various kinds, which after a time form a deposit at the bottom of the liquid more or less abundant, according to the pressure employed. These foreign matters are visible to the naked eye, and under the microscope present the usual appearance of torn vegetable substances which have been subjected to pressure. Three-quarters of an hour suffices for these substances to be precipitated to the bottom of the juice. But however long may be allowed for this subsidence, even if until fermentation sets in, the juice never becomes limpid, but always assumes a milky appearance. When examined by the microscope in this state it is seen to be quite free from *debris.* If the juice of the cane had been formed only by water holding a quantity of matter in solution, it might be more or less coloured; but after the precipitation of organic substances it should not retain this cloudy appearance. The juice is, in fact, formed of two distinct parts—the one liquid, and the other solid. The first comprises the water holding in solution the immediate organic and saline substances, the other consists of corpuscles or granules held in suspension throughout the liquid, and which cannot be separated by the same means as cellular *debris*. These corpuscles are globular, and formed by a slight and transparent, yet solid covering, and containing a semi-fluid matter. They are never more than from three to five-thousandths of a millimetre in diameter. These globules, which I have named the *granular matter* of the juice, are an integral part of the juice, and give it the milky appearance proper to it. They are found in the sap of the cane at all periods of its development. They are not readily precipitated, but may be separated from the juice without difficulty by filtration through paper. Then the juice, freed from all solid particles, appears limpid and of a light-brown colour, resembling that of clarified syrup.

It is remarkable, that in this state it may be kept 24 hours in a temperature the most favourable to fermentation, without showing the slightest tendency to it; after this period it changes in appearance, becomes cloudy, and corpuscles are developed throughout, fermentation then commences but continues slowly, and even at a temperature of 77° F. it is two days before well defined bubbles appear in the liquid. On the contrary, when the juice has been simply cleared of the vegetable fragments which it always contains, fermentation takes place very rapidly after extraction, and in a few hours the liquid becomes viscid. In the later case, fermentation is nearly complete before it has even commenced, in the juice from which the corpuscles have been separated in the manner above described. This granular matter then, plays a principal part in the fermentation of the juice, and it may be considered as the principal agent in the alteration which is developed in the juice during the first twenty-four hours after its extraction from the cane.

The boiling of cane juice deprives it of the albumen, which, coagulating under the influence of heat, combines with the globular matter, and forms flakes on the surface of the liquor. This albumen of the cane juice is of equal importance as a cause of fermentation, and to this is entirely due the alteration in the juice from which the granular matter has been separated; for the juice from which, after boiling, the granular matter and the albumen have been separated may be kept with perfect safety at a temperature of 86° F. for two days at least. At the end of this period it becomes less limpid, and the following day a light cream covers its surface, and at the same time its colour changes; but not until the end of the third day does fermentation begin.

To recapitulate—The juice filtered through a cloth, and allowed to settle, always appears more or less milky in appearance, of a slight yellowish green colour, deeper when the cane is riper or of a darker species. Excepting the remains of tissues, easily removed, this juice is in its normal state, formed part of solid granular matter, and part liquid holding in solution a certain amount of organic and mineral substance. The solid portion is formed by the globules, or corpuscles, which are suspended through the whole extent of the liquid, and differ essentially from the other vegetable principles contained in the cane juice. These globules—which, during the life of the plant, doubtless possess special physiological qualities—are of all the matters contained in the cane those which possess in the highest degree the power of exciting alcoholic fermentation. Their action appears to commence on the emission of the juice from the cane, and is always very evident at the end of two or three hours, with a temperature above 68° F. The abstraction of these globules will retard for a day the process of fermentation, and when, at the same time, the albumen is extracted, the juice will remain for two whole days without any appreciable change.

It is sufficient to carry the juice rapidly to the boiling point immediately on expression—then directly after to pass it through a filter, to have a liquid perfectly limpid, which may be kept unchanged for some time.

On the one hand, the eminently fermentible property of the juice under the influence of the globules and the albumen coagulable by heat; and on the other, the possibility of extracting these bodies, and at the same time the organic *debris*, by means of rapid, immediate boiling, followed by one filtration, so as to obtain a limpid liquid—are facts which it is sufficient to announce to show their importance. Without doubt they would lead to very satisfactory results, if they formed the basis of a new process applicable to the sugar industry.

In the ordinary practice of our manufactories at the present day such a process would have three advantages:—

1.—To avoid all immediate fermentation of the juice, and to be able to keep it for a whole day at least without change.

2.—To diminish the formation of uncrystallizable sugar.

3.—To have a concentrated limpid liquid to act upon, preserving all its transparency and original purity.

It is needful to add a few words to point out more clearly the two latter advantages. The globular and albuminous substances contributing materially to the development of the acidity of the juice, are the principal causes of the formation of glucose sugar. When they are extracted it is discovered that the acidity of the juice is only slightly augmented by the action of heat, and is always much less than if they had remained in the juice.

Again, we may remember that the means we possess for the defecation and purification of the juice are insufficient to effect it perfectly, and that it contains, when in a state of syrup, an enormous quantity of particles chiefly coagulated and albuminous granular matters.

These particles because of their weak specific gravity, are difficult to separate with clearing materials by settlement, and for the most part are found mixed with and sticking to the grains of sugar, the quality of which is thus always more or less reduced. During the process they are also often the point from which the crystals begin to form, and to which consequently they communicate a dull or brown colour, which being inherent in the constitution of the saccharine crystal, cannot possibly be removed by the washing used in the centrifugal process.

The presence of these corpuscles in appreciable quantity perfectly explains the difficulty experienced in obtaining white and brilliant sugar, when the clarified syrup is put into the vacuum pan before it has been sufficiently cleansed in the open air. This is what happens, for example, in what is called the triple effect apparatus, where the juice is enclosed after a defecation inevitably incomplete, to which it has been previously submitted.

The process which might be based on the special facts which I have endeavoured to make known, will I believe, be easily applicable in all our sugar factories; but it would be especially a powerful auxiliary to the "triple effect apparatus," which cannot for reasons given above, furnish a sugar of beautiful quality under the ordinary conditions in which the colonial sngar manufacture is obliged to exist. The process needs the application of simple filters in the form of casks furnished with a series of metallic cloths placed over them by the aid of moveable frames, and terminated by a metal sieve, covered with one or two layers of flannel. The juice flowing from the mill receives at once, the quantity of lime needed for the quality of the sugar to be made; it is then rapidly carried to the boiling point; then immediately after let into the filters disposed in such a manner as to permit a prompt and complete filtration.

(*To be continued.*)

QUEENSLAND, AS A SUGAR GROWING COUNTRY.

To the Editor of "The Sugar Cane."

Sir,

As a grower of Sugar in the colony of Queensland, I hail with pleasure the appearance of a Magazine, in whose pages the sugar interest of the world can be fairly and impartially dealt with, irrespective of politics, colour, or caste. As one of those who, amidst innumerable difficulties, have succeeded in producing both sugar and rum in some quantity, and not without profit, from cane grown in Queensland, I will, with your permission, avail myself of the pages of your first number to make a few *general* remarks on the capability of the colony, and its adaptation to the growth of sugar; whilst in some future numbers I will restrict my observations to special subjects connected with it—in particular the question of labour—white and black—and its cost to the sugar planters of Queensland.

It is not generally known that Queensland is the largest of the colonies of Great Britain. Its area is about four times that of France, and twelve times that of England and Wales; it will thus be seen that there is ample room for a very large increase of population, and that it will be a long time before the inhabitants are in each other's way. The whole of the north-eastern portion of the Australian continent is comprised within the limits of the colony. Its seaboard extends a distance of about 1,500 miles north and south; its area is about 678,000 square miles. A large proportion of the land is of first-class character—quite equal to that found in any part of the Australian continent; and, notwithstanding the disadvantage of distance, the settlement has steadily progressed.

The climate, though hot, is salubrious, and is in every way suited to the English constitution. The dryness of the atmosphere, which is its distinguishing feature, renders it more healthy than similar latitudes, which are more humid. In all ranks of life, there may be found persons who have resided for over twenty years in the colony, who exhibit a vigour and strength, quite equal to the average enjoyed in any other part of the world; in short, to all who pay proper attention to their mode of living, Queensland would be as salubrious as any part of her Majesty's dominions.

In the summer months it is unquestionably hot, but the temperature seldom attains that extreme height which it reaches in Victoria and South Australia during the hot winds to which these colonies are liable; and the nights are comparatively cool. The spring and winter months from March to October are truly delightful, and during this period no climate in the world, in my opinion, can surpass it. Queensland possesses many important rivers navigable for a considerable distance for vessels of 500 tons. The banks of the rivers within ten or twelve miles of the coast are chiefly occupied by settlers on farms of from 40 to 2,000 acres each. By the last census the colony contained about 100,000 inhabitants, about 90,000 of these being British or of British descent.

It appears from official returns that in 1868 about 32,000 acres of land were in crop, comprising maize, cotton, sugar, coffee, tobacco, vines, pineapples, bananas, mulberries, peaches, &c., beside the fruits and vegetables common to the English garden, most of which grow to great perfection.

The cultivation of the sugar cane appears likely to outstrip all the other agricultural productions of Queensland. From returns I have received very lately I find there are over 60,000 acres of land, in blocks of 320 to 1,280 acres each, leased by the Government specially for sugar and coffee growing, one-tenth part of which must be under one or other of these crops within three years from date of lease, otherwise the land reverts to the Government. As far as I remember, there were at the end of last year about 40,000 acres of freehold land held by those who have spent large sums of money on their estates exclusively for sugar cultivation, and for the erection of mills and machinery for the manufacture of sugar and rum. At the end of 1868 over 3,400 acres of sugar canes were planted in the following districts:—

	ACRES.
Logan	200
Pimpama and Albert Coomera and Nerang	800
Caboolture	410
Cleveland	376
Oxley	136
Ipswich	48
Maryborough	800
Mackay	473
Bowen, Cardwell, and Townsville	215

In these districts is comprised a portion of the land of the colony extending for about 800 miles from my own estate. I am well acquainted with most of it, and I believe it capable of producing two tons of sugar or sugar and molasses per acre. There are already ten mills and factories in existence, and others are in course of erection. As far as I am able to judge, I should think that the value of sugar and rum produced from cane grown in the districts named in 1868 would amount to about £35,000. I cannot state precisely the area of the land giving this return, but I know that the results fully support the above estimate of its productiveness.

By the end of 1870, Queensland will export both sugar and rum in addition to supplying its own wants. As a colonist of 28 years standing, and as one of the earliest to embark capital in the cultivation and production of sugar in Queensland, I unhesitatingly affirm, that sugar growing will answer the purposes of all who understand the cultivation of the soil and who are capable of conducting it economically. I speak from my own experience in the cultivation of sugar, during six years, on my estates on the Pimpama and Hotham rivers, where I have proved that it can succeed, even amidst drought on the one hand and excessive wet on the other.

The figures furnished by some other growers in my own district, show more favourable results from the crushing of 1868, but I have chosen a minimum rather than a maximum result.

In the cultivation of the cane the great drawback hitherto has been the difficulty of getting it crushed, but this difficulty is now vanishing, and the breadth of land under sugar is being increased on all sides.

Mr. Macdonald, the manager of the Cleveland Estate, who has been extensively employed in crushing the cane for small growers, gives some interesting statistics of the practical results which have come under his own knowledge, of some of the crushings of cane at Cleveland, from different parts of Logan, Albert, Doughboy, and Oxley Creek. *(See next page, Table No. 1.)*

The particulars from the plantation of the Hon. J. C. Hemsler, are circumstantial and complete, and are plain facts actually accomplished. I have not heard the ages of the various fields of cane, but this is not important. *(See Table No. 2.)*

To give an idea of the value of this produce, I sold the sugar, made on my own estate, at from 33s. to 38s. 6d. per cwt., and the rum from 4s. to 5s. per gallon.

A considerable number of homestead and other selectors have lately taken up farms in the same neighbourhood, Mr. Nind in particular having planted 60 acres with cane last season.

But, I must not trespass further on your space, I think I have said enough to prove that Queensland presents an open field alike to the capitalist and the industrious agricultural labourer for the

Table No. 1.

Grower.	Variety.	Weight of Cane.				Gallons of Juice.	Density.	Weight of Sugar.				Juice extracted per cent. of Canes	Sugar obtained per cent. of Canes
		Tons	cwt.	qr.	lb.		Baumé.	Tons	cwt.	qr.	lb.		
Lavelle ..	Bourbon ..	6	13	3	20	900	9½°	0	8	3	4	66	6·5
Woolman ..	ditto ..	4	9	1	4	600	9°	0	6	2	0	64	7·3
No. 1	Ribbon	4	1	3	10	550	9½°	0	5	3	27	64	6·4
M'Leod ..	Bourb. Rib.	53	18	3	13	7250	9°	2	17	0	23	63	5·3
Ham	Bourbon ..	180	9	1	14	24255	8½°	9	17	2	3	64	5·5
Davy	ditto ..	66	7	1	14	8920	8½°	3	3	1	6	64	4·8
Holtorf ..	Ribbon ..	9	1	2	5	1220	9°	0	9	0	6	64	5·
S. & Co. ..	ditto ..	7	16	3	27	1055	9°	0	7	3	8	64	5·
Henry....	Bourbon ..	18	15	2	27	2525	7½°	0	15	2	14	63	4·2
Another ..	Bourb. Rib.	15	1	1	10	2025	7¾°	0	15	2	12	63	4·2

Table No. 2.

No.	Area.			Gallons of Juice.	Density.	When cut.	Yield in tons.				Yield per acre.				1 ton of Sugar for Gallons of Juice.	
	A.	R.	P.				Tons	cwt.	qr.	lb	Tons	cwt.	qr.	lb.		
1	3	3	23	21·080	10° B.	Nov. & Dec.	14	0	0	0	3	11	3	18	1506	Plant Canes.
2	7	3	33	24·310	10½°	Dec.	16	3	0	24	2	0	2	14	1504	Plant Canes & Rattoons, alternate rows.
6 & 7	12	2	16	52·586	8½°	Aug. & Sept.	31	0	0	0	2	6	3	14	1696	ditto. ditto.
* 8	2	0	3½	12·580	10°	Nov.	8	18	0	0	4	8	0	5	1414	Plant Canes.
	26	1	35½	110·556			70	1	0	24	2	12	3	20	1578	Besides the sugar, 2600 gallons
											Average.				Average.	of Molasses.

* This is perhaps the largest yield known, and ought to give great encouragement to those who are struggling with the difficulties of a new plantation.

growth of the cane and the manufacture of sugar. The man of limited means need not trouble himself about anything beyond growing good cane. For, whilst he can with proper cultivation and attention with one pair of horses and the usual simple implements employed in farming at "home," produce on 10 acres of land a crop worth £130 cash value in the field—he may I think leave the manufacture of sugar and rum to those whose capital, means, and practical knowledge will at all times enable them to give the cane grower quite as much for his produce as he can hope to obtain by manufacturing for himself. In conclusion sir, I wish I had the ability to make known, as widely as the facts deserve, for the benefit alike of the capitalist, the labourer, and the mechanic, that in the neighbourhood of Pimpama, Coomera, and Murray rivers, and within a few miles of those streams, there exist vast tracts of deep rich scrub land, capable of yielding, with the proper appliances of machinery and labour, many thousands of tons of sugar per annum.

I am, Sir, yours faithfully,

GEORGE BOARD,

of Malungmavel Sugar Estate, Pimpama, Queensland.

Rayment's Hotel, London, July 12, 1869.

RESEARCHES ON THE INFLUENCE OF MANURES UPON THE SACCHARINE RICHNESS OF THE SUGAR CANE.

By M. J. Krajenbrink.

From the "Journal de l'Agriculture des Pays Chauds."

Some time ago I undertook a number of experiments upon the influence of manures on the development of the sugar cane, with the design of showing to the planters to what a large extent it is in their power to increase their yield, by being more careful, than is generally the case, to return to the soil by means of manure the substance of which it is deprived by the crops. The results at which I have arrived may serve as a starting point, and show how far the progress of agriculture is dependant on the use of manures.

Our first experiments were made with the red cane of Batavia, which is the most common variety in Java, and in the following season I repeated my experiments, using a greater variety of manures, in various combinations, and with a new kind of cane which I had received many years previously from Mr. G. M. Gonsalves, of Tessano, and known by the names of Teboe, (pronounced Tebboo) Itam, Monjet, Woelong, and half a dozen others. I considered this variety as one of the most advantageous to cultivate; it was therefore interesting to ascertain to what extent its productiveness might be increased by the use of suitable manures.

Experiments which I also concluded about this time, upon the comparative value of different varieties of canes cultivated under similar conditions, and manured with those substances which my first experiments showed to be most suitable for the cane plant, proved likewise—that this sort of cane deserves to be adopted by those planters who manufacture on their own account.

My new experiments on manures for the sugar cane entirely confirmed the previous results; but I attach a higher value to the recent conclusions at which I have arrived, because the agricultural operations were performed exactly at the proper time. The ground selected for the cane piece was precisely similar to that made use of for the comparative culture of the different species of canes, (from which it was distant by about 200 yards) being composed of the same brownish red clay which in this neighbourhood, as elsewhere in Java, covers the upper bed of the diluvium strata.

All the calculations, measurings, and weighings were performed by myself. The methods of analysis were only a little simplified. As it was more important to ascertain quantities relatively, than with absolute accuracy, and as time failed me for making simultaneous determinations with the copper test and polariscope, I confined myself to taking the sp. gr. of the cane juice, with a hydrometer registering to one tenth of a degree; I then ascertained the quantity of uncrystallizable sugar by the copper test of Barreswill, which I found to be 12 grammes per litre just at the moment the canes were cut, during the first 15 days of September. Proceeding on the results thus obtained, I deducted 15 grammes per litre for saline and nitrogenous substances, In mixing the manures, I made a point of spending as near as possible the same sum of money on each equal area. The amount spent was scarcely 33s. per acre, allowing a space of 5ft. 11in. between the rows of canes; this may be considered as a slight expense, for it is well known that *Ratoons* require very little manure.

When once it has been ascertained what is the most profitable variety of canes to cultivate, and what manures cause the greatest increase in the yield, it will then remain to be determined what quantity of this most suitable manure should be used to the best sugar cane, to produce the most advantageous economical results. This investigation is the natural sequel to a rational series of experiments on manures, and I propose to undertake it at some future time.

We have already ascertained that an expenditure of 30s. to 40s. per acre on ordinary manure is not sufficient in proportion to the capital employed in cane culture to secure the best results. I have therefore determined in future to employ oil cake meal, mixed with ashes or lime, in the proportion of 6 of the former to 1 of the latter, and in such quantity as will amount to about 55s. per acre.

In the following Table are shown the results of my experiments.

From the examination of these figures several practical inferences may be drawn. In order that the increased proportions of juice and crystallizable sugar may be relatively expressed, I take as unity the yield without any manure. In my first experiments I did not adopt this plan, but confined myself to giving the proportionate augmentations in the yield of juice, believing that the saccharine richness of the juices of canes grown with different manures varied so slightly that any little variations which did appear might be set down as merely accidental. But in my new experiments I took a different course, and the different degrees of density shown on the hydrometer are sufficient to prove that certain manures exert a direct influence over the amount of juice obtained, and also over its quality.

	MANURES.			Space Planted	Results obtained.			Tons of Canes per Acre.		Density of Juice.	Areometer gross Proportion of Sugar.		Crystallizable Sugar per Gall.	Results of each Experiment.	Produce per Acre.	
	Nature of Manure employed.	Proportion.	Quantity employed in the rows.	Area in sq. yds.	No. of Canes	Gals of Juice.	Proportion per Cane.	Mill 64 per Cent.	Mill 60 per Cent.	Degrees Baume.	Per Cent.	Lbs. per Gall.	Lbs. Avoir.	Sugar obtained.	Galls. of Juice.	Crystallizable Sugar.
														Lbs.		Tons.
1	Without Manure			495	1810	153·7	·085	11	12	10°3	18·60	2·003	1·73	264·5	1408	1·155
2	Ashes	1	1 Ponkje per Mètre	495	1800	204·0	·1133	14½	16	10°6	19·14	2·067	1·80	365·2	1979	1·6 nearly
3	Guano	1	1 Batok per 3 Mètres	495	2100	320·2	·1524	23	25	10°5	18·96	2·045	1·77	562·0	3112	2·454
4	Oilcake	1	1 ,, 1 Mètre ..	495	2110	295·5	·140	21	23	10°5	18·96	2·045	1·77	523·0	2871	2·271
5	Guanine	1	1 ,, 1 Mètre ..	495	1660	166·9	·1005	12	13·2	10°85	19·60	2·119	1·85	314·3	1641	1·359
6	Dry Blood	1	1 ,, 3 ,, ..	501	1950	262·5	·1346	19	20·5	10°6	19·14	2·067	1·80	474	2541	2·04
7	Dry Residue of Defecation, &c.	1	1 Ponkje per Mètre	501	2300	323·9	·1408	23	25	10°35	18·69	2·014	1·74	561·0	3112	2·42
8	Farmyard Manure	1	1 ,, ,,	501	2020	283·1	·1401	20	22	10°4	18·12	2·024	1·75	494	2720	2·145
9	Guano and Ashes	1 8	3 Batoks ,,	501	1980	234·0	·1181	16½	18	11°	19·87	2·151	1·88	436	2247	1·884
10	Oilcake and Ashes	3 6	3 Batoks ,,	507	2020	227·7	·1127	16	17·½	11°1	20·05	2·172	1·90	430	2158	1·832
11	Guanine and Ashes	3 6	3 Batoks ,,	507	1840	159·9	·0870	11	12·2	11°3	20·42	2·215	1·94	308·6	1516	1·315
12	Dry Blood and Ashes	1 8	3 Batoks ,,	513	1930	190·7	·0990	13	14·4	11°1	20·05	2·172	1·90	360·2	1792	1·518
13	Oilcake and Lime	6 1	3 Batoks 2 Mètres..	519	1970	277·0	·1457	19	20·8	11°2	20·23	2·194	1·92	529·1	2560	2·203
14	Oilcake, Dry Blood, and Ashes	3 1 5	3 ,, ,, .. 3 ,, ,, ..	525	2040	289·3	·1418	19½	21·4	10°8	19·51	2·109	1·84	529·4	2648	2·18
15	Oilcake, Guano, and Ashes	3 1 5	3 ..	531	2260	·364·0	·1610	24½	27	10°9	19·69	2·130	1·86	683·2	3444	2·78
16	Oilcake, Guano, Dry Blood, Guanine, and Ashes	3 1 1 3 1	3 for 4 Mètres ..	538	2090	306·6	·1470	20	22·2	10°8	19·51	2·109	1·84	561·1	2737	2·51

Ponkje (small basket) has no equivalent in English measure. Batok: half a cocoa-nut shell. Metre, 3ft. 3in.

The following Table will show that it is a mistake to suppose that nitrogenous manures sensibly diminish the proportion of sugar obtained from the juice. Our experiments show, on the contrary that the use of guano, oilcake, and dry blood, either separately or combined, produce a yield in sugar greater than is obtained without manure, and even greater than when fresh farm-yard manure or the scum and residue of the clarifiers have been employed.

Increased yield in Juice and in Sugar deduced from the preceding experiments.

Manure Employed.	Juice.	Sugar.	Increase or decrease of Sugar obtained from a certain quantity of Juice.
1.—Without Manure	1	1	
2.—Ashes	1·33	1·38	+·05
3.—Guano	2·08	2·12	+·04
4.—Oilcake	1·92	1·96	+·04
5.—Guanine	1·1	1·17	+·07
6.—Dry Blood	1·72	1·76	+·04
7.—Dry Residue from Coppers and Clarifiers	2·11	2·09	—·02
8.—Farm-Yard Manure	1·84	1·83	—·01
9.—Guano and Ashes	1·52	1·63	+·11
10.—Oilcake and Ashes	1·48	1·58	+·1
11.—Guanine and Ashes..........	1·04	1·14	+·1
12.—Dry Blood and Ashes........	1·24	1·31	+·07
13.—Oilcake and Lime	1·8	1·9	+·1
14.—Oilcake, Dry Blood, and Ashes	1·88	1·88	0
15.—Oilcake, Guano, and Ashes....	2·4	2·4	0
16.—Oilcake, Guano, Dry Blood, Guanine, and Ashes	2·0	1·94	—·06

(To be continued.)

ON SELF-UNLOADING CENTRIFUGAL MACHINES.

In the *Mechanics' Magazine* for June 18th, 1869, may be found the drawings and description of a very ingenious arrangement of a self-unloading Centrifugal Machine, recently patented by Mr. J. F. Brinjes, of London.

Although the thought and ingenuity, which have been expended in designing this and many other machines having a similar object in view, are very considerable, we are, nevertheless, much inclined to believe that this thought and this ingenuity have been misdirected. In order to prove this position, we propose briefly to enquire what are the advantages and disadvantages which may be expected *a priori* to belong to any arrangement of self-unloading centrifugals.

The chief advantages sought are evidently economy of space and diminution of labour; and in order to obtain these two advantages the machine is made continuous instead of intermittent in its action, while the labour of unloading is performed automatically, instead of as in the ordinary machine, by hand. The advocates of the self-unloading arrangements might possibly allege a saving of time, but as this only means that say three ordinary machines must be used to get through the work of two self-unloading machines, this gain simply resolves itself into economy of space. As we shall hereafter shew, though it may be possible to employ fewer machines, there will be no economy in first cost.

We freely grant that the advantages of economy of space and diminution of labour would to some extent be attained by an *efficient* self-unloading machine. If, however, fine sugars are to be operated upon, the cost of passing these through the centrifugal is already so small, that any saving which can be thus effected is really inappreciable. If, on the contrary, sticky sugar of low quality is to be worked up, the time occupied by the mere draining is so many times longer than that needed for loading and unloading, even on the ordinary system, that the possible gain is reduced to a minimum,

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since the time required for the actual draining will be the same in the one machine as the other.

Besides, it not unfrequently happens with very low sugars, that it is necessary to stop the machine in the middle of the draining operation and mix up the charge afresh, as the sugar next the outside of the machine has formed itself into an impervious coating, thus preventing the escape of the syrups from the inner portions of sugar. The self-unloading machines offer no means of avoiding this difficulty, which, in them, would have to be met in the same way as in the ordinary machines—*i.e.* by stopping the machine, and mixing the charge afresh by hand; indeed, in some of them, among which may be mentioned the one already more especially alluded to, it would be much more difficult to deal with these very low sugars than in the ordinary machines, because, as in the former the work is progressive and continuous, there is no easy means of turning back, as it were, and doing a portion of it over again, as is absolutely requisite in some cases.

It might also probably be alleged by the advocates of the self-acting system that the power necessary for driving was less where this plan was adopted, because the power ordinarily lost in starting and stopping the machines, was saved in those which were continuous in their action. Against this, however, must be set off the fact that most, if not all, of the self-unloading arrangements require power to work them additional to that needed for keeping the machine in motion so as to drain the sugar, and the consumption of power for these additional purposes would probably fully equal that lost in an ordinary machine by its frequent stoppages. In addition to this, it would be quite possible (though we believe it has never been done) to employ most of the power required to stop one centrifugal of the ordinary make in giving the first start to another machine of similar construction.

We have hitherto spoken of the benefits which might be expected from the use of self-unloading machines, and we think we have shown that on careful examination these advantages shrink into a very small compass.

We have now to do with the disadvantages of the system. It is complicated, and this in a machine moving habitually at so high a speed is a great evil, because the more numerous the parts (and especially the moving and wearing parts), of a machine, the more numerous in a progressive ratio are its chances of getting out of order. This liability to get out of order becomes of greatly increased importance when it is remembered that the cylinder of a centrifugal, the very part to which all these complications are attached, is exposed while at work to a strain equal to that on an ordinary high pressure steam boiler, and that like a boiler it will explode, scattering death and destruction around it, if any portion gives way. A pressure of from 40 to 50 lbs. per square inch on the sides of the cylinder—arising solely from the centrifugal force of the sugar contained in it, is very usual; while, in order to arrive at the total strain, we have to add that due to the tendency of the cylinder to tear itself to pieces, and this might amount to another 25 lbs. on the square inch, thus giving a total strain of some 65 or 75 lbs. per square inch.

Now if we have a great number of moving parts exposed continually to this strain, some or other of them are sure frequently to be out of order. But if any of these parts are out of order, the machine will not perform its work properly, and the very first requisite of a machine is, *that what it professes to effect, it should effect* WELL.

The liability of the various moving parts to get out of order will, however, not only interfere with the efficiency of the machine, but it will make frequent repairs necessary. Now, there is nothing more annoying than to have continually to stop for repairs. When this is the case, there is never any certainty when work can be completed, and also much space is lost through machines standing idle, and much labour wasted through the machine requiring it, being thrown out of work. Then the cost of repairs soon forms an important item. It comes in driblets, it is true, and is therefore often not so much noticed as it should be; but it is a perpetual incumbrance which cannot be shaken off.

Because a centrifugal machine is quite capable of exploding, as our newspaper columns testify only too often, it is of the utmost importance that it should be extremely strong and simple in its construction, and little liable to derangement. All additions to it which either detract from its strength, or offer a fresh chance of something going wrong, or add to the intensity of the strain upon the cylinder, are so many added chances of serious accident.

The evils arising from complication, and the consequent necessity for frequent repairs, are of especial consequence in machinery intended for the colonies. There, where skilled labour is scarce, where repairs can only be made under great disadvantages, and where, indeed, it frequently happens that any considerable breakdown cannot be repaired at all, it is of the utmost importance that the machinery employed should be both simple and strong, and no other advantage can compensate for the absence of these qualities, or even for their presence in only an inferior degree.

Another disadvantage of the self-unloading system is that it is costly. Not only is the weight of material required for the construction largely increased—and this alone would add considerably to the cost—but the workmanship is augmented in perhaps even a greater ratio. As a consequence, the first cost of a machine to get through a certain quantity of work would most certainly be greater if the machine were of the self-unloading than if it were of the ordinary description, even although the latter might require to be a little larger in size in consequence of its work being intermittent instead of continuous.

We think that anyone taking an impartial view of the case will be brought to the conclusion at which we have ourselves arrived—that, viewed in the abstract, it is never likely that the balance of advantages will lie on the side of the self-unloading machine, since, in order to obtain some little economy in space and saving in labour, simplicity must be abandoned, and all the evils attendant on complication embraced.

COST OF GOVERNING THE WEST INDIA ISLANDS.

The government of the West India Islands by this country is so cumbrous and costly that these dependencies have no chance of prosperity, and the mother country has little benefit from her possessions. The chief curse to which they are subjected is a monstrous swarm of officials, who prey upon the colonists, and draw away from the islands the capital which would otherwise fructify in the dependencies themselves. Let us take for example the group of the Leeward Islands, comprising St. Kitts, Antigua, Nevis, Montserrat, and Dominica, for the purpose of ascertaining the amount of their population and commerce, and to investigate the manner in which they are ruled. The five islands we have named have an aggregate area less than one-third of the county of Norfolk, while the portion which could be cultivated is much less. Perhaps the portion of the whole aggregate area of the five islands under cultivation is not equal to one-twentieth of the county of Norfolk. The united population is, probably, in the present year 110,000—not one-third of the population of the single town of Birmingham. These islands are within easy distance of each other—Dominica, the farthest south, being not more distant from St. Kitts, the farthest north, than the most southerly of the Orkney group is from the most northerly. Each of these small fragments of a county is regarded by the Home authorities as a distinctive possession, requiring officials of all kinds, and an administration framed upon the model of our great dependencies. Antigua, (population 37,125) has a Governor and Commander-in-Chief at a salary of £3,000 a year. He has a private Secretary and Aide-de-camp at £300. There is a Bishop, of course, because the climate is good and there is little missionary work to do, and he receives a salary of £2,000 a year. Then there is a Chief-Justice, with a salary of £1,000, together with fees; an Attorney-General, with the more modest allowance of £400; a Treasurer and Comptroller of Customs, with a salary of £500; a Colonial Secretary, with a salary of £550, and various other officials. The Governor-in-Chief and other official persons must do something for their salaries; and the year 1866 we find they managed to extract from the population of 37,125 men, women, and children—the men being chiefly poor agricultural labourers—an income of £43,548. The mother country has taken care to abolish all import duties upon articles of food, as taxes which are both unjust to the people and impolitic for the country. But we, nevertheless, sanction the most gross departure from all these principles by the petty governments of the West India Islands, which are completely under the control of the Colonial Office, and could be made to do what is right by a stroke of the pen.

The CHANCELLOR of the EXCHEQUER said most truly in his Budget speech, "If we cannot at this time of day trust enough to the doctrines of political economy and free trade to believe that when you raise nearly a million sterling from the very poorest of your people you do an immense amount of mischief, what is the use of abstract science or speculation at all?" If Parliament applauded that declaration, and is prepared to abolish the 1s. duty on corn, what can we say of the Government which permits these mediæval tariffs of the West Indian Islands to continue? In Antigua the import duty on a barrel of beef or pork was £1 in 1866; there was a duty of 1d. per pound upon butter, of 1s. 2d. per quintal on dried fish, of 2s. 2d. per hundred pounds weight of rice, of 6s. upon a barrel of flour—in short, a taxation almost wholly raised from the necessaries of life. Export duties, moreover, are laid upon the staple productions of the island. Thus, we find a duty of 3s. 4d. per hogshead on sugar, and even the new industry of cotton culture must be strangled in its infancy by a tax of ¼d. per pound. The hogshead of sugar has thus to pay a heavy tax when shipped, and it has again to pay a heavy tax when it reaches our shores. The wonder is, not that sugar cultivation is backward, but that it survives at all. It may be said that a revenue must be raised somehow to meet the expenditure. We reply that the expenditure is in great part caused by a swarm of officials who may very well be dispensed with, and by a multiplication of establishments which is the result of keeping up a separate administration for the islands. The exports of Antigua for 1866 amounted to £291,861, and the imports to £203,257. The amount of taxation was thus very nearly 10 per cent. of the gross trade—an amount which necessarily bears very heavily on a small colony. Montserrat, a "beautiful gem of the sea," has a population of 7,645, who are taken care of by a President, subordinate to the Governor of the Leeward Islands, aided by an Executive and Legislative Council and a Legislative Assembly. The civil establishment of this slip of territory, twelve miles in length and eight in breadth, costs £657; the judicial, £700; the ecclesiastical, £431; the police, £523; the gaol, £142; poor and lunatics, £628; the interest of the public debt, £667; and other items make the total expenditure for 1866 amount to close upon £5000, being about £2 10s. a head for the grown men, whose wages as prædial servants amount from 8d. to 1s. per day. Of course there are import duties and export duties, and all the other caricatures of larger kingdoms, although the total trade only amounts to £38,000 per annum. The cost of government is about 13 per cent on the gross trade. The population of St. Kitts is about 24,440, and it is governed by a Lieutenant-Governor, aided by an Executive Council and a Legislative Assembly, with a paid President. The salary of the Lieutenant-Governor is £1,300 and fees. There is a Chief Justice, with an income of £750, and £100 as Chief Justice of Anguilla, a neighbouring rock. The Secretary to the Government has £400 a year, the Auditor-General £300, the Treasurer £500, the Police Magistrate and Attorney-General £600, the Sergeant-at-Arms and Provost Marshal £450, the Immigration Agent £250, the Archdeacon £250—in all the expenditure amounts to £24,926, which is levied from import duties, tonnage on vessels which approach the island, and in other barbarous methods. The gross trade of St. Kitts in 1866 was £348,013, so that the expenditure was about 8 per cent. on the whole. For Nevis and Dominica we have another crop of officials, with import and export duties, and all the evils of a small community, ruled at its own expense as if it were a kingdom. It costs £6,884 to govern Nevis, with a population of 9,822, and £18,367 to govern Dominica, with a population of

25,666. In all, the cost of government of these islands, which together do not make up one-third of the county of Norfolk in extent, and the population of which is less than one-third that of Birmingham, is £112,556.

It is no more difficult to rule these islands than to administer the government of the Orkney and Shetland group, which together form one Scotch county. The population is quite as peaceable, and there are no difficulties otherwise which are not of our own making. There is no Governor-in-Chief of the Orkneys, nor are there chief justices, or bishops, or treasurers, or colonial secretaries, or nonsense of any kind unbefitting a scattered group of islands. There are two local Judges, and the County Board and Burgh Magistrates take care of the peace, which, in truth, is never disturbed. The government of the five West India islands we have named, if consolidated, ought not to cost £20,000, or less than a fifth of its present amount; and the first fruits of such a reduction would be to do away with the necessity for duties on imports and exports, and thus afford a great stimulus to the production and trade of the islands. If the right policy were adopted these colonies might become models of prosperity. They have within them all the natural elements of wealth, their people are as industrious as others when properly paid, and their insular position enables them to transport produce easily to all the markets of the world. At present no interinsular trade exists, because of the variations of tho tariffs and the fresh imposition of duties at each island. There is little inducement to persons to put capital into the sugar or any other production, as the taxes fall with crushing weight upon all large establishments. In short, we have done everything we possibly could to dwarf and stunt the growth of these communities, and in the matter of the import and export duties on articles of first necessity we sin against light. The Government as a whole knows and upholds the benefits of free trade, but the Colonial Office, as a part of the whole, maintains the condemned system, and subjects to its withering influence communities which need all the light and air of freedom. We have restricted our remarks to a group of the Leeward Islands, but the same evils weigh upon the other West

Indian communities, and on some of them in even a greater degree. We do not know whether LORD GRANVILLE proposes to signalise his tenure of office by a display of masterful inactivity, or by doing something to make his administration memorable. If the latter, we earnestly commend to him a consideration of the position of the West Indian Dependencies.—*Morning Star.*

VARIATIONS IN THE QUALITY OF CONCRETE.

BY ALFRED FRYER.

Concrete is well described by Dr. Nield as "The dry extract of Clarified Cane Juice;" and as cane juice varies considerably in quality, concrete must vary in like manner and to an equal extent.

The sugar found in beet-root is almost exclusively of the crystallizable variety, so that although beet-root concrete is distinguished by the presence of a considerable amount of salts, it is almost destitute of uncrystallizable sugar. Cane concrete, on the other hand, contains salts in so small a quantity that, as compared with beet, they may be disregarded; but uncrystallizable sugar or fructose is always present, sometimes in larger quantity, sometimes in smaller.

The central joints of cane, when grown under favouring circumstances, and when fully matured, yield a juice which contains almost as small a quantity of fructose as that of the sugar beet, but the upper knots yield this intractable form of saccharine in considerable quantity. Each cane that is not perfectly ripe, and each one that remains uncut after it has attained maturity, yields fructose in greater abundance. Canes that have grown rapidly in moist places, or from the stimulus of heavy rain when nearly ripe, yield fructoso in extreme quantity. Thus concrete varies in quality with every cane patch, and, much as *sugars* differ from one another in quality and value, *concretes* will differ still more.

The main difference in value between samples of beet-root sugar, is caused by the salts they contain, and as these cannot be determined except by analysis, the skill which refiners have acquired in the estimation of the value of sugars by their appearance, is not applicable to beet sugars. Fortunately, fructose is easily distinguished. Its characteristics are stickyness and deliquescence, and just in inverse proportion to the extent of these qualities is the value of the concrete. Concrete is at times damp and not sticky; its value then is merely reduced by the extent of the moisture it contains.

Five per cent. of the sugar present in the average cane juice of Antigua is of the uncrystallizable variety, therefore as the concretor when properly used, unlike some systems of manufacture, does not degrade any perceptible quantity of cane sugar, this is the proportion of fructose usually found in the concrete from that island; * and this five per cent. is the average result of the juice of canes, some of which yield much more, and others much less than this proportion. It is not an unusual circumstance, however, to find concrete, when made from such canes as have been previously described, containing twice as much glucose, and in particular cases even three times as much. On the other hand, when the canes are very good, the proportion of fructose falls to one or two per cent., and concrete of this quality, is everything that the refiner who makes loaves, or who adopts the Scotch system, can desire.

The refiner must remember that as concrete varies even more than sugar in quality, what chiefly concerns him in its purchase is the proportion of glucose, and here his experience in estimating the value of sugars by their appearance will not lead him astray.

The French Imperial Commission, after refining concrete in Havre, reported that "concrete is of the same value as raw sugar which presents similar appearance, and behaves in the refinery in a similar manner." Had the Commission gone more closely into details, it might have added that it presents three special attractions to the refiner—1st. That being uninjured by the manufacture it presents little or no caramel, and that the colour being merely vegetable extractive matter is easily removed by animal charcoal, and therefore the liquor leaves the cylinders unusually brilliant and

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* 4·4 per cent. of fructose was the average in Antigua concrete in 1868.

free from colour. 2nd. Concrete does not contain dirt, which is so abundant in many low sugars. 3rd. It is much less acid than sugars of similar appearance. The Inventor of the Concretor is a Refiner, and it is to be expected that its produce will be such as at a fair price he will desire to operate upon.

The Concretor is not readily deranged, and is easily worked, but like most other machines used in the arts, it requires care, and in some cases it is evident from the samples, that sufficient care has not been exercised in its use. The planter must remember that good concrete cannot be made from bad juice, and that even with good juice care is needed. He must also remember that it is within his power in most cases to improve the value of his concrete very materially by selection of patches of cane only as they become ripe, and by discarding the practice far too common, of recklessly reaping a crop with reference alone to convenience of carting.

The evils produced by great and continued heat are almost in proportion to the quantity of fructose in the juice, so that the concretor is of greater value in the concentration of bad juice than of good; from the latter a grey, dry, granular, splendid concrete is made, instead of a bright muscovado and a little molasses, but from the former a heavy sticky concrete may be made, containing ten or twelve per cent. of fructose instead of a small quantity of low sugar and a large quantity of black molasses.

From Trinidad, Antigua, and Central America, concrete of medium quality has been received, when the juice treated by the old process would make nothing other than molasses. When the planter obtains twelve per cent. of the weight of his canes in concrete, instead of five or six per cent. in Muscovado sugar, he will find the manufacture of concrete much more profitable than that of sugar, even if he should obtain a less relative price than his produce is ever likely to bring; and so long as his concretor is worked with care, and his canes fall before the cutlass only when ripe, he may rest satisfied that the poorer the concrete produced, the more he will have gained by the use of the concretor.

THE COLONIAL COMPANY, (LIMITED).

The fourth ordinary general meeting of the shareholders was held on Thursday, June 17th, the Right Hon. E. P. Bouverie, M.P., in the chair.

The report of the directors, was as follows :—

"In laying before the proprietors their report for the past year the directors are glad to be able to congratulate them on the results. From the profit and loss account herewith, it will be seen that the gross profits of the year 1868 have amounted to £106,703 19s. 3d.; deduct the charge from business expenses and interested on debentures, £34,443 15s. 1d., there remains a net profit of £72,260 4s. 2d.; add balance of profit and loss brought forward from last year, £13,969 14s. 9d.; together, £86,229 18s. 11d. From this is to be deducted interest due to vendors on the amount credited in advance on the 10,000 shares allotted to them under contract, at 5 per cent., £1,250; *ad interim* dividend of 10s. per share, declared in July, 1868, amounting to £14,759 10s.; *ad interim* dividend of 10s. per share, declared in January, 1869, amounting to £14,759 10s.; together, £30,769; leaving a balance of £55,460 18s. 11d. The directors recommend that a further dividend of 12s. per share be now declared, which will amount to £17,711 8s. The total dividend thus declared being 32s. per share, is at the rate of 8 per cent. per annum. The directors propose that the dividend for the year shall be free of income tax. A further sum of £25,000 has been transferred to the reserve fund, making a total reserve of £75,000. The balance of undivided profits to be carried forward to this year's account will be £12,749 10s. 11d. The directors are confident that the proprietors will concur with them in the soundness of this policy. They have thereby been enabled, not only to maintain the commission business of the company, and to keep up efficiently their sugar plantations, but also to expend a large amount in the improvement of their West India property, without making any call upon the proprietors beyond the amount per share contemplated in the prospectus. This expenditure has been incurred in the purchase, on favourable terms, of lands contigious to their estates, and of one estate in Demerara, in the extention and the improvement of the cultivation, and the erection of more powerful machinery, and works capable of manufacturing a larger quantity of produce, more rapidly and more economically than hitherto. They are of opinion that by thus augmenting the permanent source of the company's income out of revenue, they are laying the most solid foundation for its future prosperity. The directors are glad to be able to inform the proprietors that the latest advices lead them to hope that the drought in British Guiana, alluded to in their last report, has terminated. It has been greater in duration and severity than any ever known in that colony; but, on the other hand, the satisfactory price of sugar, which has ruled during the present year, will in some measure compensate for the deficient production thus occasioned."

The Chairman said he thought that the accounts would bear favourable comparison with those of the previous year, and the directors felt, in presenting this report, that they were entitled to ask the concurrence of the shareholders in the opinion which they entertained—looking at the circumstances against which they had had to contend—that they had been very successful in the management of the business of the company. It had been said outside on the one hand, that the dividend which they proposed to declare was too small, and on the other, that it was too large; but he thought that the directors, in declaring an 8 per cent. dividend, had come to a sound conclusion, and a conclusion justified by the means at their command. It had been suggested that they had done well because circumstances had operated in their favour. Now that was not the case. What they thought was, that given fair circumstances—not favourable circumstances—they would have been able to do better, and to have shown even a more satisfactory state of affairs than were disclosed last year. They did not seek for excessive crops or high prices, but the fact was that up to last year the produce had not quite reached the average prices which had ruled for several years, and owing to circumstances which were not under their control, which had occurred at Demerara, the crops had not been all they could wish. He was enabled to state the average of prices for eight years, and for the three years they had been in operation. For the eight years prior to 1866, Manilla averaged 23s. 3d., and in 1866 the price was 19s. 2d., showing a decline of 4s. 1d.; in 1867, taking the eight years, but excluding 1866, the average was somewhat lower, *i.e.* 22s. 5d., whereas the prices ruling in 1867 were 20s. 4d.; then in 1868 the average for the eight years was 21s. 10½d., while last year the price was 21s. 1d., thus giving a lower average of 9½d. He thought this showed at any rate that there was no reason to suppose that their operations were successful owing to the high prices obtained for the produce brought to market. Having substantiated this fact, he would now say that, with respect to the crops, that they had not realized in Demerara so largely as they would have done if they had only had ordinary seasons. Then, last year, when they met, they had occasion to speak of the drought which prevailed in Demerara up to that time, but it had since continued, and it was the longest drought known in the history of that country. This had effected their produce, and yet, under all these adverse influences, they had brought out a result which, all circumstances taken into account, must be said to be a good result. Still they had no reason, looking at the transactions of last year, to think that it was a result much in their favour, as arising from large crops and high prices, and they would have been greater sufferers from the drought had it not been for the way in which they had cultivated their estates. They had endeavoured by judicious tillage to put them into a sound productive position. But they had endeavoured to improve the system of managing these estates, and the fact of their being large properties enabled them to get the best general superintendence and advice to be got in the colony, and thus to whip up those who were laggards to the higher standard of those who were skilful. Sugar cultivation, if it was to be successful, must be carried on subject to every process of improvement in the machinery for its manufacture. They all knew that there was great competition in sugar, and it followed that unless those who were interested in this article kept pace with the improvements made in its manufacture, the trade was not likely to be so profitable as it ought to be. Between 1866 and 1868, they had laid out and paid, in round numbers, some £84,200 in improvements.

The shareholders would observe that, while they had paid fair dividends, they had paid out of revenue no less a sum than upwards of £36,000. How had this been spent? It had been spent in making additions to the machinery used in the manufacture of sugar, in concretors for Trinidad, on steam ploughs, and partly on irrigation machinery. The steam plough had not been in work long enough for them to judge of its results, but anyone who knew anything of its operations in this country must know that it would make a considerable difference in the item of cost connected with cultivation. But then there were difficulties to be encountered in the colonies in the working of intricate machinery which did not exist in this country. In England there were intelligent mechanics, who, if the machinery got out of order, could repair it in a few days, whereas in the West Indies they had not got them; so that when the steam ploughs were worked by men who were not familiar with their use, they did not produce those favourable results which might under other circumstances be looked for.

On the question of irrigation there did not appear to be any doubt, as there were now promising fields of cane, that would not have had a cane upon them but for this pump; and the manager was persuaded that if they had had an engine at work, that upwards of 200 hogsheads of sugar would have been added to the crop. He (the chairman) saw that while some of the estates made good returns, others made bad returns—but it was an advantage they derived from the large area they had under cultivation, that they were able to bring their general produce to a good average. They enjoyed, in this respect, just that advantage which large landed proprietors had over small landed proprietors—a large proprietor was able, out of the large average profits of his general estate, to meet these demands. It was mentioned in the report that they had made purchases of land, and he wished to stato that their objcet had not been so much to add to the landed estates of the company as to securo patches of land adjoining what they already possessed; for thoy thought as a rule they could do better by laying out their money in improving what land they had got. There was one point in the report which the shareholders had in their hands, he had a word to say about, and that was the reserve. They (the shareholders) would observe that they had standing in the name of reserve a sum of £50,000, and that they proposed to add £25,000 out of the year's profits to that sum, leaving a balance to be carried over of £12,749, and he hoped that the shareholders approved of the course they had taken in this matter. There were those who approved of keeping a large reserve, but counselled its being locked up in boxes, or invested in consols. It appeared to him to be a mistake to assert that a reserve fund should be locked up in consols. It was prudent for a banker to havo a large reserve on demand; but a company who knew what their engagements were, had no need to keep a large reserve for account, cash, or consols—especially if they saw that they could use it profitably in their business. They had been able notably to do what they had dono by retaining this large reserve in their hands, and using it in the business; and in that way they had made a better thing of it than they would if they had kept it locked up. A fair view to take of the caso was this. Supposing they wero to wind up their affairs to-morrow, tho reserve would rank as assets; and the other assets being fairly and accurately stated, there would be £75,000 to divide amongst the shareholders out of the profits. He did not propose to indulgo in anticpating the results of the future, for prophecy was a risky thing, but they (the directors) flattered themselves that the affairs of the company were now in a sound and healthy condition. It did not become him to speak of political questions, but if from any cause the produce of Cuba should be diminished, there could be no doubt that such a circumstance would improve their West India property. Without saying what would take place with regard to tho government of Cuba—whother it was to remain in the hands of Spain, or fall to those of our aspiring cousins in America—it was impossible that the artificial condition of society which was involved in slavery could continue. Slavery was doomed. They (the directors) had anticipated this, and had taken their measures accordingly. It could not last long, and tho day of emancipation would see Cuban productions diminished, and a great increase in West Indian produce.

Mr. R. Gillespie (deputy-chairman) had much pleasure in rising to second the motion, and in doing so he most cordially endorsed the observations of the chairman. It was unnecessary for him to make any lengthy remarks; but he felt it was their duty to thank Mr. Bernard for tho zeal he had displayed in their interest.

Mr. Simpson had a word or two to say about the accounts. Different minds saw things from a different point of view. It seemed to him that the £75,000 reserve was surplus earned, and it was a question with him whether the £25,000 should not be divided among them, for they had earned, not 8 but 12 per cent. during the last year. He felt, however, great reliance on what the directors proposed, and would think that they had good and sufficient reasons for keeping this amount in reserve. After referring to the shipping business of the company, he hoped the chairman and directors would continue to retain office, and do as well for them in the future as they had done in the past.

Mr. H. Littledale said that though a dividend of 8 per cent. had been proposed, he would have been content with 6 per cent. He was glad the directors used a wise discretion in this matter.

Mr. J. Hodgkin expressed himself highly satisfied with the statement of the chairman, but he would have been glad if the accounts had been a little more explicit—had, in fact gone more into details.

The Chairman, in reply, said that whilst the directors were willing and anxious to give the accounts with the greatest fullness and clearness, still it must be borne in mind that when an attempt was made to render accounts too explicit, they often became complicated. In conclusion, the chairman said that the directors were enabled to declare an interim dividend at the rate of five per cent. for the present half-year, which would be paid with the other dividend.

On the motion of Mr. Harold Littledale, seconded by Mr. A. Macgregor, the directors who retired by rotation were re-elected.

On the motion of Mr. Hodgkin, seconded by Mr. Simpson, the auditors, Messrs. Price, Holyland, and Waterhouse, were re-appointed.

Mr. Simpson moved that the cordial thanks of the meeting be given to the chairman and directors for their able management of the affairs of the company, and alluded particularly to the zeal and ability of Mr. Bernard.

The resolution was seconded by Mr. Alfred Fryer, of Manchester, who expressed his satisfaction with the report, and said the result of the working of the company fully demonstrated that West Indian property could be made remunerative. He disagreed with Mr. Hodgkin as to the increase of detail in the accounts, as the less the company informed its competitors of its proceedings the better. He thought it was not advisable to increase capital vested in ships, as this was rather a sugar-growing company than a shipowning company. He highly approved of the reserve fund, and would be glad to see it increased.

Sir J. Lubbock, Bart., entirely agreed with the remarks of the previous speaker with respect to the reserve fund, which he preferred keeping in the shape of a reserve fund to appropriating it to the reduction of the liability on the shares.

The Chairman briefly acknowledged the vote of thanks, and said that the shareholders were not only under great obligations to Mr. Bernard, but their thanks were equally due to Mr. McColman and Mr. Hadow, who had managed the branch at Demerara with the greatest ability.

EXTRACTS FROM "JOURNAL DES FABRICANTS DE SUCRE."

PLANT CANES SENT FROM EGYPT AND QUEENSLAND TO MAURITIUS.

Seventeen cases, containing heads of sugar cane, have been sent via. Suez to Mauritius, to be divided amongst several planters of that colony.

These heads of cane have been obtained from his Serene Highness the Viceroy of Egypt, who has not only offered them gratuitously from his own sugar plantations in Upper Egypt, but has given orders for the avoidance of all difficulty and delay in their transport. "Our acknowledgments are due herein," says M. G. L. Adam, in a letter announcing their despatch, "not only to his Highness, but also to M. Eugene Ponjade Ghika, a native of Mauritius, at present Consul-General of France at Alexandria, and to M. M. Oppenheim, Nephew and Company, of that city, without whose active assistance I should not have succeeded in obtaining and sending these canes."

He adds that the canes of Upper Egypt are of the finest and richest quality, and that the greatest care and attention have been taken in the choice of the plants; that he hopes that the experiment will be a happy one, and that it will be a great satisfaction to him to be of use to his native place after the recent calamities which have excited the sympathies of all those who have ever had any connection with the island.

These cane shoots, which had began to bud a little, were received in a sufficiently satisfactory state to be planted in the Jardin des Pamplemouses, and distributed amongst many of the planters of the colony.

Another consignment of cane plants has been made from Queensland by the care of Dr. Meller, who has selected and forwarded a large quantity of different varieties not hitherto grown in Mauritius, which had also been received in good condition.

Letter relative to experiments made with Fryer's Concretor on the estate of M. Cottin, and addressed by him to the Mayor of Baie-Mahault, (Guadaloupe) 3rd June, 1869.

The period of trial and experiment having closed, and sensible progress having been made by my employés in the working of the Concretor, I am now able to furnish you with precise notes of the result.

When I observed that progress had become regular and satisfactory, I put former trials quite aside, and made fresh ones on a large scale with these results:—

With the juice at 10½° Baumé, and a pressure of the mill estimated at 65 per cent., I have ascertained,—

1.—That the return has been 13 per cent., (12·88) 229·305 K. of cane, yielding 29·540 K. of sugar concrete.

2.—That the manufacture has averaged 520 K. (10¼ cwt.) per hour.

3.—That the cane trash has been sufficient and far more than enough for both evaporation and crystallization.

4.—That three men and an overlooker are sufficient to conduct the process.

5.—That the quality of the sugar is very good.

I am convinced that, beyond these results, already very satisfactory, much better may be obtained in time with longer practice, especially in all that concerns the work of preparation, and that, with more complete defecation and filtration, the concrete would far surpass in quality, the type of *"bonne quatrieme."*

There is, unquestionably, a considerable saving in increased production, and in the economy of fuel and labour.

The success appears to me very decided, and I am sure that the programme of the Inventor is realized to the full extent.

In a paper addressed to the Academy of Sciences, Paris, Mr. Rensard shows that a certain quantity of nitrogen is developed in the manufacture of beet root sugar, and that in this way a quantity of ammonia is found, which has hitherto been wasted. A manufactory consuming 20,000 tons of beet roots per annum, might be made to yield 87½ cwts. of sulphate of ammonia, at a very low cost.—*Galignani.*

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

2031. J. Gregory, King's Wood Iron Works, near Bristol. *Apparatus for charring and preparing animal charcoal.* Dated June 24, 1868.

This invention relates to an improved mode of constructing the revolving retorts used in charring the substances made into animal charcoal, by inserting in suitable grooves fixed inside the retort a perforated plate or perforated plates. The perforations the inventor makes in an elongated form, narrow in comparison with their length, and he places them in such a position that one series of perforations may be inclined to a corresponding series. He finds that a plate or series of plates dividing the retort into two equal divisions may be used with advantage.—Patent abandoned.

2134. A. Fryer, Manchester. *Concentrating sugar.* Dated July 4, 1868.

The patentee passes the gases or products of combustion, either with or without an admixture of air, between a series of spiral blades or volutes symmetrically arranged and revolving round a common centre. The external edges of these blades, in their lowest position, are immersed in the solution to be operated upon, and by their revolution, the solution flowing over their surfaces towards the common centre preserves the surfaces in a moist state. The heated gases passing over these moisened surfaces effect the concentration desired.—Patent completed.

2144. A. Fryer, Manchester. *Concentrating sugar.* Dated July 6, 1868.

These improvements refer in part to improvements in the apparatus described in the specification of letters patent, dated February 14, 1865 (No. 418). The curved blades are placed as close together as can be done without interfering with the flow of the liquor or other solution over their surfaces, so as to divide the air, thus bringing every portion of it into more intimate contact with the solution to be evaporated or concentrated, and thereby more perfectly exhausting the whole of the heat contained in the air. The curved blades are placed at from five-eighths to one-eighth of an inch apart, according to the nature and degree of saturation of the solution to be acted upon.—Patent completed.

2558. W. B. Espuet, Jamaica. *Extracting molasses.* Dated August 15, 1868.

The sugar to be operated on is placed upon a surface of wire gauze, or other open material forming the bottom of a chamber, which, when the sugar has been introduced, is closed airtight by a cover. Beneath this chamber there is a space in which a vacuum is produced by any means, and then the air enclosed in the upper chamber over the sugar, forces its way downwards through the sugar into the vacuum space, and in so doing carries with it the moisture from the sugar.—Patent completed.

2560. A. Smith, Glasgow. *Sugar.* Dated August 17, 1868.

This relates to the manufacture of sugar in improved modes, and by means of general arrangements, or combinations of apparatus performing the same. The apparatus comprises a number of rectangular vessels or pans set on two straight walls, and with the fire gases from one or more furnaces, at one end, passing lengthwise under and heating them. The bottoms of the pans are formed with corrugations to increase the heating surface. A channel is formed across the ends of the corrugations, in order to completely drain or empty the corrugations when required.—Patent completed.

2970. J. Gregory, Bristol. *Preparation of animal charcoal.* Dated September 28, 1868.

This relates to an improved construction of retort. The retort is constructed by inserting in a revolving heating cylinder a plate, or series of plates, having perforations therein of a rectangular or other suitable shape, made in a direction inclined from the axis of the cylinder.—Patent completed.

3031. J. Rogers, Brooklin, U.S.A. *Reviving bone black.* (Partly a communication.) Dated October 3, 1868.

This consists, first, in the after treatment of the exhausted bone black or animal charcoal, by neutralizing any excess of lime present, by the use of a solution of the superphosphate of lime. Second, in removing any excess of organic matter present in the exhausted bone black, by steeping it in a solution of nitrate of ammonia, and then reburning it.—Patent completed.

3033. B. E. R. Newlands, Charlton. *Manufacture of manure and salts of ammonia.* Dated October 3, 1868.

This consists, first, in taking any organic matter containing nitrogen (such, for instance, as dried blood, woollen waste, or leather clippings), and treating it with vitrol or sulphuric acid, at an elevated temperature of from about 300deg. to 400deg. Fah., and allowing the mixture resulting to digest, until the organic matter has been thoroughly acted upon, and converted into a black mass. To the substance resulting, native carbonate of magnesia or magnesium (limestone, by preference), is then added, in a state of fine division, so as to neutralize the excess of acid. Second, in utilizing the nitrogen contained in the impure sulphocyanide of ammonia obtained by washing or triturating oxide of iron. The requisite amount of lime is added, to liberate the ammonia contained in the solution, and the ammonia it contains distilled. This collected in an acid, such as sulphuric acid. The sulphur cyanide of calcium remaining in the distilling apparatus is then taken, and, if dry, is mixed with slaked lime, but, if wet, dry lime is used. The mixture is subjected to dry distillation, and the ammonia evolved is collected in an acid, by preference, sulphuric acid. The invention further relates to the conversion of the nitrogen contained in sulphocyanide of calcium, resulting from the purification of coal gas into ammonia, by dry distillation, either with slaked or dry lime, as the case may be.—Patent completed.

SUGAR STATISTICS—GREAT BRITAIN.

To 17th July, 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	18	1	3	11	33	44	54	5	10	28	98	116	56	6	9	25	97	98
British East India	6	2	..	..	8	5	7	2	..	..	10	2	6	4	..	..	10	7
Mauritius	3	1	..	1	4	4	5	1	5	4	16	30	9	1	5	4	19	32
Cuba	9	3	2	8	23	23	10	5	12	25	53	55	7	5	11	29	51	45
Porto Rico, &c. ..	2	1	..	1	3	7	1	4	1	1	7	9	2	4	..	2	8	6
Manilla, &c.	39	8	..	2	48	38	19	12	1	2	34	25	9	15	1	..	25	27
Brazil	1	11	2	1	16	20	1	19	9	13	42	40	1	23	8	14	47	37
Beetroot, &c.	1	..	..	1	2	1	9	3	1	10	23	28	11	3	1	10	25	33
Total, 1869 ..	78	27	8	24	137	142	107	51	39	84	282	305	101	61	35	85	282	284
Total, 1868 ..	67	42	6	27	5 decrease		112	61	33	99	23decrease		111	57	31	85	2 decrease	

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS. MAY 31ST, 1869.

	1869.	1868.
United Kingdom	90	85
France	70	67
Holland	50	45
Zollverein	16	5
United States	122	61
Cuba	86	105
Total	434	368

CONSUMPTION IN EUROPE AND UNITED STATES FOR YEAR ENDING MAY 31ST, 1869.

For 12 months	1868-9	1867-8.
Europe	1221	1180
North America	421	418
	1642	1598

From LICHT's Monthly Circular,

THE PRODUCTION OF BEET SUGAR IN EUROPE, FOR THE SEASON 1868-9 against 1867-8.

Tons.	Tons.
625,000	634,000

STATE OF MARKETS.

The market in Great Britain is very steady and a good demand from refiners is experienced, specially for West India. The continued dry weather has checked the operations of some of the refiners at Greenock, who are dependent on Shaw's water for their supply. In looking towards the future, the effect of the almost certain extinction of the slave trade and slavery in Cuba and Porto

Rico, (whatever may be the result of the insurrection in Cuba,) must be taken into account, and on the other hand, the fact that the sugar markets of the world contain an increased stock of 12 per cent. over that at the same period last year.

The following is condensed from the *Journal des Fabricants*:—The season of 1868-9 in the Zollverein has just closed; duty has been paid on 2,500,000 tons of beet roots, producing 207,500 tons of sugar—a return of 8·40 per cent. of sugar.

As regards the season of 1869-70 in Europe, there is, as we have said, an increased surface of 10 per cent. of beet root, and except for casualties of season, we may hope for a surplus of 50 to 100 thousand tons over last year's crop.

As regards Colonial crops, that in Cuba, favoured since January by abundant rain, promises to be very productive, if not damaged by the insurgents. The crop of Mauritius is estimated at 125,000 tons. Of the crops of other colonies, notably of Java, the prospect is equally favourable.

We will sum up the facts noted and examine them—1, Augmentation of stock; 2, Decreased consumption in England and United States; 3, Greater area than last year devoted to beet culture. 1, The increase of the general stock arises in part from considerable transactions of the Americans with Cuba. 2, The diminution of the quantity taken for consumption in England and the United States is temporary, and is explained by light stocks in second hands, and may be rectified by a return of the demand. 3, The more considerable extent of growth of the beet in Europe does not always imply the certainty of a great crop, for the yield of this plant depends greatly on the weather, which has been very irregular and abnormal up to the present time. In short, we do not think the sugar prospects present anything unfavourable.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

THE

SUGAR CANE.

REGISTERED FOR TRANSMISSION ABROAD.

No. 2. SEPTEMBER 1, 1869. Vol. I.

☞ The writers alone are responsible for their statements.

ANALYSIS OF MEGASS ASH,

By Robt. Angus Smith, Ph.D. F.R.S.,;

With Remarks Relative to its Use as a Manure, and as Fuel.

TWO SAMPLES OF THE ASH OF SUGAR CANE.

No. 1.

Soluble in Hydrochloric acid.	Carbonic acid	CO_2	0·22	per cent.	
	Chlorine	Cl	0·48	,,	
	Sulphuric acid	SO_3	0·92	,,	
	Lime	CaO	4·23	,,	
	Magnesia	MgO	3·52	,,	
	Peroxide of Iron	Fe_2O_3	2·86	,,	
	Phosphoric acid	PO_5	2·54	,,	
	Soda	NaO	0·17	,,	
	Potash	KO	2·21	,,	
	Copper	Cu	0·16	,,	17·31
Insoluble in do.	Silica	SiO_3	6·73	,,	
	Sand, &c.		74·75	,,	
	Carbon		1·22	,,	82·70
					100·01

The &c. includes—Al_2O_3, CaO, (Mn. trace.) NaO, KO, (SO_3.) PO_5, SiO_3.

No. 2. Highly Heated.

Soluble in Hydrochloric acid	Carbonic acid	CO_2	0·49	per cent.	
	Chlorine	Cl	0·18	,,	
	Sulphuric acid	SO_3	0·12	,,	
	Lime	CaO	3·92	,,	
	Magnesia	MgO	2·40	,,	
	Peroxide of Iron	Fe_2O_3	2·14	,,	
	Phosphoric acid	PO_5	2·60	,,	
	Soda	NaO	0·19	,,	
	Potash	KO	2·10	,,	
	Copper	Cu	a little	,,	14·14
Insoluble in do.	Silica	SiO_3	5·81	,,	86·31
	Sand and Carbon		80·50	,,	
					100·45

ASH No. 1.—SUGAR CANE.

100 grms. of Ash with 800 cub. Cc, of Water.

50 cub. Cc, of this contain:—

Sulphate of Lime	CaO, SO_3	0·01499	grammes.	
Sulphate of Magnesia	MgO,SO_3	0·01405	,,	
Suphate of Potash	KO, SO_3	0·01194	,,	
Chloride of Potassium	K, Cl	0·05992	,,	
Carbonate of Potash	KO, CO_2	0·00012	,,	
Chloride of Sodium	Na, Cl	0·01080	,,	
				0·1118

or

Chlorine	Cl	0·03535	,,	
Suphuric acid	SO_3	0·02369	,,	
Lime	CaO	0·00617	,,	
Magnesia	MgO	0·00468	,,	
Potash	KO	0·03764	,,	
Soda	NaO	0·00567	,,	
Carbonic acid	CO_2	0·00004	,,	
				0·1132

Cane Ash got by burning cane in the Laboratory.

5·76 per cent... .. soluble in hot water.

Proportion remaining insoluble in Water:—

30·61	KO	Potash	per cent.
9·88	NaO	Soda	,,
1·60	PO_5	Phosphoric acid	,,

&c.

The following analysis, furnished by Professor Anderson to A. Crum Ewing, Esq., may be compared with the above.

Silica	23·65
Peroxide of Iron	4·24
Lime	3·66
Magnesia	3·76
Potash	16,06
Soda	2·48
Phosphoric Acid	3·76
Sulphuric Acid	7·40
Chlorine	3·19
Carbonic Acid	0·84
Charcoal	0·79
Sand	30·17
	100·00

Comparing these analyses, it is evident that very wide discrepancies exist. These may indicate in part that the ashes of different varieties of cane are not invariable in their constituents, but they mainly lead to the supposition that some of the samples have been wetted by rain previous to analysis. Thus, the importance of stowing the ash under cover is manifest. Indeed, several years ago, Mr. Fryer, in a lecture, thus described some experiments he made on this substance :—"Megass Ashes, fresh from the copper-holes, gave on the average eleven pounds of salts—principally potash—to the hundred pounds of ashes. But these salts are very soluble, and exposure to very little rain avails entirely to remove them, so that a gentleman wishing to test this result by experiments of his own, failed to find a single grain of crystallizable salts in a large quantity of ash, because he had operated not upon fresh ashes, but upon those which had been exposed to several showers."

"He therefore recommended the careful return to the ground of the megass ash day by day, before any of the soluble salts had been removed by rain."

MEGASS AS MANURE.

The deterioration of land by the successive growth of similar crops without intermission is well known, and to prevent it, manuring is universally resorted to. It is also resorted to for the purpose of increasing the yield. Manuring is compensation to the land for the removal of those substances it has lost by the growth of crops upon it.

To maintain the fertility of land, those substances must be oftenest supplied to it that are most frequently removed, and the problem submitted to the cultivator for solution is the discovery of the missing materials in any given case, and how these missing materials may be most cheaply and effectually supplied.

It is evident that a fertile soil would remain fertile were all the substances that the crop removes returned. In ordinary farming this is generally sought to be accomplished by employing the return from cattle sheds; but in those estates under cane cultivation where cattle are fed on them this return is rarely, if ever, sufficient to entirely make good the loss the soil sustains in the reaping of successive crops.

An examination of the constitution of the ashes of a plant is the easiest method of determining both the mineral substances that are assimilated during its growth and their relative proportion. A plant, to maintain its full vitality, must find a sufficiency of proper food. It is not enough that there be present plenty of those substances it assimilates largely, but also of those it feeds upon sparingly. Undue proportion may or may not always prove detrimental; but an entire absence of any—even of the seemingly least important—must be considered hurtful.

The refuse of the sugar cane megass possesses largely those mineral matters upon which the plant has fed. By burning, this megass yields an ash wherein these mineral matters are present in a more concentrated form. Megass ash contains pretty nearly all the mineral matter necessary for a future crop, and is therefore really a valuable substance. However, as, during the rearing of a crop of canes, the soil has lost other than mineral matter, the ash of megass cannot be considered as a perfect manure for another crop; but, so far as earthy substances are required, it should prove a cheap and ready source of them to cultivators of the sugar cane.

Megass as Fuel.

The employment of megass as fuel may render interesting some facts concerning its combustion. Megass "is simply the fibrous part of the cane from which the juice has been extracted by the mill. Its heating power is computed at 4,359 units; that is better than wood, and equal to turf of average quality.—(*Count D'Adhemar.*)

The megass examined was the product of a large and powerful mill in the West Indies. It was in pieces varying in size from 8 inches long to the state of sawdust, the average size being about 2 inches.

ANALYSIS GAVE—

Carbon	42·06
Hydrogen	5·51
Oxygen	40·99
Ash	2·11
Moisture	9·33
	100·00

Or calculated without moisture,—

Carbon	46·4
Hydrogen	6·07
Oxygen	45·2
Ash	2·32
	100·00

It consequently contains a little more hydrogen and carbon, and a little less oxygen, than pure cellulose.

1·1525 lbs. of oxygen are required for the combustion of every pound megass; or, 1 lb. of megass requires for its combustion 65.3 cubic feet of air at the ordinary temperature and pressure.

One pound of Wigan Cannel Coal, consisting of

	Per Cent.
Carbon	80·07*
Hydrogen	5·53
Nitrogen	2·12
Oxygen	8·08
Sulphur	1·50
Ash	2·70
	100·00

requires for its combustion 142·3 cubic feet of air under the ordinary conditions of temperature and pressure.

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* Miller's Elements of Chemistry, Vol. II. p. 150.

Total heat attained by burning one pound of	Units of heat; *i.e.*, pounds of water raised through 1° C.	Pounds of water at 100° C. evaporated off.
1. Wigan Cannel Coal	8060·638	15·03
2. Megass ……..	3409·115	6·36

Wigan Cannel coal gives, therefore, on complete combustion, 2·36 times more heat than megass, and requires 2·18 times more air to burn it per pound.

Coal practically takes double the amount of air needed in complete combustion of the oxygen. Will wood or megass, which is practically light wood or shavings, take double also? I think it nearly certain to take the oxygen out of the air better than coal will.

Air required to burn	Theoretically.	Practically.
1. 1 lb. Wigan Coal ……	142·3	300 (about)
2. 2·36 lbs. Megass (equal to 1 lb. Wigan Coal in heating power)….	154·1*	275†

PRODUCTS OF COMBUSTION OF MEGASS.

	Doors open.	Doors shut.
Carbonic acid…………	8·66	7.18
Oxygen ……………	9·87	12·36
Heavy Hydrocarbons ….	Trace	0·99
Marsh Gas…………	….	2·36
Hydrogen ………….	….	0·04
Carbonic Oxide……….	….	….
Nitrogen …………	81·47	77·08
	100·00	100·00

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* Space required also for about 12 cubic feet of water-vapour evaporated from the megass.

† The result of a small experiment.

When the doors were shut a good deal of air passed up, but the gases were imperfectly burned. I think it would not be the case in ordinary circumstances; the reason, probably, is the excessive speed of draught. On the whole the experiments point to this—that until some better mode of burning is found, the chimney space must be nearly the same for the amount of work to be done, whether coal or megass is used. 9 per cent. of oxygen is rather a small amount to be found in the gases of chimneys through which coal products only pass.

RESEARCHES ON THE JUICE OF THE SUGAR CANE,

AND ON THE MODIFICATIONS TO WHICH IT IS SUBJECT DURING MANUFACTURE, IN THE ISLAND OF MAURITIUS.

From the French of Dr. Icery.

(*Continued from page* 32.)

III.—DENSITY.

The density of the juice being the one of its properties most easily detected, and depending chiefly on the quantity of sugar it contains, has always attracted the attention of planters, who, to the present time, use no other means than ascertaining the density, for determining the saccharine richness of the cane. But the rude and defective instruments which are employed often render the determination quite illusory, and the conditions in which it is effected greatly increase the error.

Without taking notice of the temperature and the aeration of the juice, or the organic *débris* which it may hold in suspension, a small glass instrument, which generally has nothing of the hydrometer about it but the form and the name, is introduced into it, and from the indications obtained in this manner the saccharine richness of the cane juice from the mill is estimated.

The density of juice determined with care furnishes, however, valuable data, which, compared from month to month, and from year to year, may be very useful in ascertaining the yield of canes cultivated under the same conditions, and even may sometimes give an idea sufficiently precise of the results of a crop, the cutting of which has only begun. But to attain this end it is indispensable that certain conditions—happily, easily realised—should be satisfied. The first is to operate always at the same temperature—that of 77° Farht., for example, to which it is always easy to bring the juice, because the mean temperature of the first month of cutting is 74° F. in the shade, and in the last month 80° F.; the second is the use of a correct instrument, whatever may be the principle of its graduation. The ordinary saccharometers of Baumé have on a very short shank too great a number of principal divisions, to be employed with exactitude on juice of which the extreme limits are usually from 8° to 12°.

In order to obviate this inconvenience, and at the same time to ensure greater precision in experiments of this nature, I have constructed a saccharometer with a long cylindrical shank marked only from 6° to 13°, and with each of the principal divisions marked to tenths; so that with this instrument, the density of juice may be registered to one-tenth of a degree. But in order that this instrument may be really useful to the planter, it is necessary that it show him approximately the proportion of sugar which may be extracted from the juice of which it has determined the density.

Different methods have been proposed to effect this, all based on the proportion of sugar equal to a certain quantity of distilled water at a particular temperature. They are all defective, because a solution of crystallizable sugar, variable only by the quantity of saccharine contained in it, cannot be compared with juice in which entirely different substances (sometimes in very noticeable quantity) other than crystallizable sugar enter, these substances themselves varying considerably, according to circumstances, different areometrical degrees. Experience alone—partly gained by determination of the densities of a great number of different juices, and partly by comparative chemical analysis of the same liquids—can enable us to form a table of any exactitude.

Based on the analyses of juice (not fewer than 100) which I have made during the last two years, I have constructed the following table, in which, from the degrees of the saccharometer, I have calculated the quantity of crystallizable sugar in one litre of juice, and in 1,000 grammes of this liquid, that is the proportion of juice in volume and in weight. In the fourth column of this table are shown the great differences caused by the presence in the juice of other matters than sugar. But I will not anticipate what I have to say further on this head, on the modifications of which they are cause; it is sufficient now to indicate the part they have in the determination of the density of the juice of the cane.

Quantity of Sugar contained in Juice, given in Volume and in Weight, Corresponding to the Principal Divisions of the Saccharometer of Baume; Calculated from a Series of Experiments made on Juice at 77° F.*

Saccharometer.	Lbs. of crystallizable Sugar per Gallon of Juice.	Weight per Cent. of crystallizable Sugar in Juice.	Weight per cent. of other matters than crystallizable Sugar, chiefly fructrose.
4°	·28	2·6	4·9
5°	·49	4·8	4·7
6°	·78	7·4	4·0
6¼°	·85	7·9	
6½°	·91	8·6	
6¾°	·98	9·2	
7°	1·05	9·9	3·6
7¼°	1·11	10·5	
7½°	1·18	11·1	
7¾°	1·24	11·7	
8°	1·31	12·3	3·2
8¼°	1·37	12·9	
8½°	1·44	13·5	
8¾°	1·52	14·2	
9°	1·59	14·9	2·6
9¼°	1·65	15·5	
9½°	1·72	16·1	
9¾°	1·80	16·7	
10°	1·88	17·4	2·1
10¼°	1·96	18·0	
10½°	2·04	18·7	
10¾°	2·11	19·4	
11°	2·17	20·0	1·5
11¼°	2·26	20·6	
11½°	2·30	21·1	
11¾°	2·37	21·6	
12°	2·44	22·7	1·3

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* We have adapted this table to English weight and measure.

PART SECOND.

1.—Composition of the Cane and of Juice in General.

The word juice is used to designate the liquid extracted from the cane by means of pressure, greater or less. It contains, immediately on expression, a quantity of solid particles, sometimes of great tenuity, floating all through its volume. These are fragments of fibre and cellular vegetable matter, resulting from the direct action of the press or the rollers on the cane which has passed through them. It is always easy by allowing it to stand, or by rough filtration, to separate the particles which do not form an integral part of the juice. Certain authors have wrongly assigned them a place in the constituent elements of this liquid, and given them the very improper name of coloured feculæ. I have shown before, that after deducting foreign matters, there still exists in the juice, as in other vegetable sap, organic corpuscles under the form of globules, distinct and transparent, of a diameter of 3 to 5 thousandths of a millemetre; and I have shown the importance with which the presence of these microscopiæ should henceforth be regarded in the manufacture of cane sugar.

The composition of juice proper—*i. e.*, freed from all solid particles—has been differently determined by those who have examined it at different epochs, and it is not even yet perfectly known. The analyses made towards the end of last century reflect the imperfection of the means then at the disposal of organic chemistry, and furnish only general results of very doubtful accuracy. At the commencement of the century, chemists of great merit, with the object of throwing some light on the staple manufacture of the colonies, of which the imperfection was generally acknowledged, proposed to ascertain the exact nature and proportions of the matters constituting the juice of the cane; but the difficulty of preserving the juice during a long voyage rendered the first efforts in this direction of little effect. The beetroot was analyzed, and its composition and structure perfectly known, whilst the sugar cane was still the object of erroneous conjecture.

It is only within the last five and twenty years that cane juice has been examined with care and success by an able chemist (M. Peligot), who occupies at present a most distinguished rank in France.

The relative quantities of water, of sugar, and of mineral and organic substances were determined by him, and the figures by which he showed his results are those still given in the most recent works on the subject. This distinguished chemist has, then, rendered great service to the sugar industry by exploding, from analysis of the cane, many substances which it was pretended entered into its composition, and in giving to the cane planters a clear and precise detail of the primary matters on which they have to work. But it is certain that if, instead of operating in France on juice exclusively from fully ripe canes, he had extended his researches in the colonies themselves on juice extracted from the plant at different epochs of its development, he would have modified certain conclusions contained in the scientific memoir he published on the subject. The opinion which he has expressed on the state of the sugar in the cane—an opinion to which all chemists since have subscribed—may be founded on truth, so far as concerns the results of the analyses he had himself made ; but it does not agree with facts brought to light by direct and repeated experiments. In fact, the juice contains not only, as is now admitted, crystallizable sugar, but also sugar uncrystallizable ; and the quantity of the latter varies even in different parts of the same cane, and at different periods of its development. I shall set forth at the proper time, in a special chapter, this question—so interesting to the colonial planter ; and I shall put in evidence of the facts which I come to announce, and the circumstances under which the state of the sugar in the cane is normally modified. I shall also devote a special place for the examination of the organic substances other than sugar—the divers mineral salts, for instance, which enter into the formation of the juice.

Viewed generally, cane juice consists of sugar and water holding in solution a certain quantity of matter, organic and mineral. Considering only the sugar and water particularly, and grouping the other substances under two distinct heads, according to their vegetable or mineral nature, I have determined the average composition of cane juice from the different species of canes grown in Mauritius, from many practical analyses made during the last two years, from the mature plant, and from localities differing in soil and temperature, as under:—

Water	81·00
Sugar	18·36
Mineral Salts	0·29
Organic Substances	0·35
	100·00

In the following table, where I have embodied the results of seventy-eight analyses made in every possible condition of exactitude, may be seen the variations which the different substances undergo according to the age of the cane, the period at which it is operated on, the part of the plant examined, and the locality where it is grown. In this table will also be found sufficient indications of the relative saccharine richness of the different species of cane, and the differences in the quality of the sugar from the same canes subjected to greater or less pressure.

ANALYSES OF CANE JUICE.

No.	Date.	Estates.	Species.	Age.	(1) Reaction A. Acid. R. A. Rather Acid. V. A. Very Acid.	Temperature Fahrenheit.	Degree Areometric.	Density.	Weight of Albuminous Matter.	Weight of Ashes.	Indications of Saccharometer.		Indications furnished by Chemical Analysis.			Observations.
											Direct Notation.	Weight of Sugar per Gallon of Juice.	Absolute Quantity of Sugar per Cent.	Quantity of Crystallizable Sugar per Cent.	Quantity of Sugar Uncrystallizable	
				mos.								lbs.				
1	Apr. 1864	La Gaieté ..	Bellouguet Plant Canes	12	R. A.	77°	9·1	1068	·0054	....	85·8	1·4	13			Body of Canes.
2	,,	,,	,, ,,	,,	,,	,,	5	1036	·0066	....	31·9	·62	7	5	2	Heads of Canes.
3	July 1864	Q. Victoria ..	Diard Plant Canes ..	18	,,	,,	9	1067	·0042	....	99·3	1·62	16			
4	Aug. 1863	La Gaieté ..	Bamboo ,,	15	A.	,,	9·8	..	....	....	109·	1·78	17			
5	,,	,,	,, ,,	..	,,	,,	9·7	..	....	....	108·3	1·68	16			
6	,,	,,	Otaheite ,,	..	,,	,,	9·8	..	....	....	110·5	1·8	18			
7	,,	,,	Bamboo & Otaheite Plant Canes	..	,,	,,	9·7	..	....	....	108·9	1·78	17			
8	,,	Argy	Bamboo, 2 years, Ratoons	..	V. A.	,,	9·5	..	....	....	107·	1·75	17			
9	,,	Deep River ..	Bellouguet Plant Canes	18	,,	,,	8·8	..	....	....	96·8	1·58	15·5			
10	,,	,,	Bamboo Plant Canes	,,	,,	,,	9·1	..	....	....	97·9	1·6	15			
11	,,	Bol Etang ..	Bellouguet ,,	,,	,,	,,	8	..	....	....	80·	1·3	13·5			
12	,,	La Gaieté ..	Bamboo ,,	15	,,	,,	10	..	....	....	113·6	1·86	18·			
13	,,	,,	Pinang, 3 years, Ratoons	12	R. A.	,,	9·4	..	....	....	101·7	1·66	16·			
14	,,	,,	Bellouguet Plant Canes	15	V. A.	,,	9·1	..	....	....	96·8	1·58	15·7			
15	Aug. 1864	Q. Victoria ..	Bamboo Plant Canes	18	R. A.	..	9·5	1072	·0056	....	108·1	1·76	16·5			
16	,,	La Gaieté ..	,, ,,	17	,,	..	8·9	1066	·0045	....	97·9	1·60	16·			
17	,,	,,	,, ,,	16	,,	..	9·7	1073	·0046	....	107·2	1·75	16·5			
18	,,	,,	,, ,,	3	,,	..	6·7	1050	·0031	....	53·9	·88	10	7	3	Shoots short and thick.
19	,,	,,	,, ,,	3	,,	..	6·5	1049	·0038	....	59·9	·98	11	7	4	

ANALYSES OF CANE JUICE. *(Continued.)*

No.	Date.	Estates.	Species.	Age.	(1) Reaction. A. Acid. R. A. Rather Acid. V. A. Very Acid.	Temperature Fahrenheit.	Degree Areometric.	Density.	Weight of Albuminous Matter.	Weight of Ashes.	Indications of Saccharometer.		Indications Furnished by Chemical Analysis.			Observations.
											Direct Notation.	Weight of sugar per Gallon of Juice.	Absolute Quantity of Sugar per Cent.	Quantity of Crystallizable Sugar per Cent.	Quantity of Sugar Uncrystallizable	
				mos.								lbs.				
20	Aug. 1864	La Gaicté ..	Bamboo Plant Canes	6	R. A.	..	5·8	1043	·0055	·0030	50·6	·82	10·5	8	2·5	
21	”	”	Melees............	14	”	..	9·7	1072	·0088	·0036	105·5	1·72	17	16·7	0·3	
22	Sep. 1863	”	Bellouguet & Bamboo Plant Canes..	15	”	..	9·8	..	....	....	109·	1·78	17			
23	”	”	Bellouguet & Bamboo, 2 yrs, Ratoons	12	”	..	10·2	..	....	....	117·5	1·91	18			
24	”	”	Bellouguot, 2 years, Ratoons	”	V. A.	..	9·5	..	....	....	102·6	1·67	16·5			
25	”	Beau Rivage.	Bamboo, 1 year, Ratoons	”	R. A.	..	10·5	..	....	....	126·	2·06	19			
26	Sep. 1864	La Gaieté ..	Bamboo Plant Canes	15	”	..	9·4	1070	·0037	·0032	107·8	1·76	17	16·76	0·24	
27	”	Bel Etang ..	Mixed............	17	A.	..	8·4	1063	·0029	·0018	84·7	1·38	14	12·4	1·6	
28	Oct. 1863	La Gaieté ..	Bamboo Plant Canes	15	R. A.	73	10·4	..	....	....	117	1·91	18			
29	”	”	” ”	”	”	”	10·6	..	....	....	124·8	2·04	19			
30	”	”	” ”	”	A.	”	10·8	..	....	....	127·6	2·09	19	....	....	
31	....	”	Guinghan ”	”	”	”	10·2	..	....	....	123·5	2·03	19	....	....	Taken in the same conditions.
32	....	”	Bellouguet ”	”	”	”	11·2	..	....	....	135·8	2·2	20	....	....	
33	....	”	Bamboo Ratoons ..	”	”	77°	11·2	..	....	....	134·7	2·2	20	....	....	Canes in which the disease had begun.
34	....	”	Guinghan ”	”	”	”	12	..	....	....	141·9	2·32	20			
35	....	”	Bellouguet Plant ..	”	R. A.	”	10	..	....	....	112·2	1·83	17			
36	....	”	Pinang, 1st Ratoons	”	”	75°	10·2	..	....	....	117·7	1·91	17·5			
37	....	”	Pinang and Bamboo 1st Ratoons	”	”	”	10·1	..	....	....	117·7	1·91	17·5			
38	....	”	Bellouguet Plant Canes	15	V. A.	”	10·5	..	....	....	124·5	2·03	19			

ANALYSES OF CANE JUICE. *(Continued.)*

No.	Date.	Estates.	Species.	Age.	(1) Reaction A. Acid. R.A. Rather Acid. V.A. Very Acid.	Temperature Fahrenheit.	Degree Areometric.	Density.	Weight of Albuminous Matter.	Weight of Ashes.	Indications of Saccharometer.		Indications furnished by Chemical Analysis.			Observation.
											Direct Notation.	Weight of Sugar per Gallon of Juice.	Absolute Quantity of Sugar per Cent.	Quantity of Crystallizable Sugar per Cent.	Quantity of Sugar Uncrystallizable.	
				mos.								lbs.				
39	Oct. 1864	La Gaicté ..	Bamboo Ratoons ..	13	R.A.	77°	4·2	1031	·0071	·0048	17·6	·28	4·7	3·4	1·3	Heads of Cane Obtained from the same Plantation.
40	,,	,,	,, ,, ..	,,	V.A.	,,	9·8	1071	·0037	·0044	114·9	1·88	17·5	17·3	0·2	Body of Cane
41	,,	,,	,, ,, ..	3	R.A.	,,	5·5	1040	·0043	·0024	34·4	·56	7·5	5·1	2·4	Shoots short and thick.
42	,,	Beau Rivage.	Bamboo Plant Canes	15	,,	..	9·9	1075	·0046	·0031	113·6	1·85	17	16·7	0·3	
43	,,	Q. Victoria..	Mixed	18	,,	77	10·	1075	·0033	....	114·9	1·88	17	16·5	0·5	
44	,,	Bel Etang ..	,, ...	..	,,	..	8·3	1062	·0066	....	89·6	1·46	14	12·8	1·2	
45	,,	La Gaicté ..	Bamboo	2	,,	..	2·2	1016	·0049	·0054	4·6	7	2·7	1·6	1·1	
46	,,	,,	Diard Plant Canes..	15	,,	..	10·9	1083	·0027	·0021	130·9	2·14	19·7	....	....	From same Canes 1st pressure.
47	,,	,,	,, ,,	..	,,	..	10·6	1079	·0015	·0023	125·4	2·04	18·9	....	....	2nd pressure.
48	,,	,,	Pinang ,,	..	,,	..	11	1083	·0020	·0013	130·4	2·13	19·6	....	....	From same Canes 1st pressuro.
49	,,	,,	,, ,,	..	,,	..	10·4	1079	....	·0023	123·2	2·01	18·5	....	....	2nd pressure.
50	Nov 1863	,,	Bamboo ,,	13	V.A.	..	10·8	..	....	....	129·8	2·12	19·5			
51	,,	,,	Pinang and Bamboo Plant Canes	15	A.	..	10·3	..	....	....	123·2	2·01	19·			
52	,,	,,	Pinang Ratoons....	..	,,	..	11·	1083	....	....	132·	2·16	19·5			
53	,,	,,	Bellouguet ,,	..	,,	..	10·7	1080	....	....	124·3	2·02	19·			
54	,,	,,	Guinghan ,,	..	,,	..	11	1083	....	....	131·4	2·14	19·5			
55	,,	,,	Bamboo ,,	..	,,	..	11·9	1090	....	....	144·	2·35	21·			
56	,,	,,	Bellouguet ,,	..	V.A.	..	11·9	1090	....	....	143·5	2·35	21·	....	....	Bellouguet diseased.
57	,,	,,	,, ,,	..	,,	..	11·2	1083	....	....	136·7	2·24	20			
58	,,	Q. Victoria..	,, ,,	..	A.	78	10·6	1080	....	....	125·4	2·04	19			
59	,,	Constance ..	Bamboo & Guinghan 2nd Ratoons	..	,,	..	11·2	1085	....	....	134·5	2·20	20			
60	Nov 1864	La Gaicté ..	Otahoite ,,	14	R.A.	77	11·4	1086	·0023	·0031	139·7	2·28	21			
61	,,	,,	Bellouguet Plant Canes	15	,,	..	11	1083	·0045	·0025	130·9	2·14	19·7			

ANALYSES OF CANE JUICE. *(Continued.)*

No.	Date.	Estates.	Species.	Age.	(1) Reaction A. Acid. R.A. Rather Acid. V.A. Very Acid.	Temperature Fahrenheit.	Degree Areometric.	Density.	Weight of Albuminous Matter.	Weight of Ashes.	Indications of Saccharometer.		Indications Furnished by Chemical Analysis.			Observation.
											Direct Notation.	Weight of Sugar per Gallon of Juice.	Absolute Quantity of Sugar per Cent.	Quantity of Crystallizable Sugar per Cent.	Quantity of Sugar Uncrystallizable.	
				mos.								lbs.				
62	Nov 1864	La Gaicté ..	Mixed Ratoons....	13	R.A.	77	10.2	1073	·0038	....	120·4	1·96	18·2	17·9	0·3	Large & ripe } same
63	,,	,,	,, ,,	2	,,	..	..	..	....	....	11·	·18	3·8	2·5	1·3	New Shoots } Canes
64	,,	,,	Guinghan ,,	13	,,	..	5·2	1037	·0068	....	40·	·65	6·4	5·2	1·2	} Juice from tops of
65	,,	,,	,, ,,	..	,,	..	6·6	..	....	....	58·	·94	10·8	9·4	1·4	} Cane.
66	,,	Labourdon ..	Bolleuguet, 2nd Ratoons	..	V.A.	..	11·6	1087	·0052	·0032	135·3	2·21	21·5	21·0	0·5	
67	,,	,,	Diard, 1st Ratoons .	..	R.A.	..	11·2	1084	·0053	·0041	133·1	2·17	20·			
68	,,	,,	Guinghan ,,	..	,,	..	14·6	1087	·0043	·0033	138·6	2·26	20·9			
69	,,	La Gaicté ..	Mixed	2	,,	..	4	..	....	....	18·1	·29	6·8	4·2	2·6	{ Recent shoots { rapidly grown.
70	,,	,,	Bolleuguet ,,	13	,,	..	4	..	....	....	8·2	·13	5·4	4·3	1·1	Heads of Canes.
71	Dec. 1863	,,	Pinang & Bamboo Plant Canes	..	A.	80	11·3	1086	....	....	135·3	2·2	20·			
72	,,	,,	Guinghan & Bamboo Plant Canes	..	,,	79	10·9	1080	....	....	131·	2·14	19·5			
73	,,	Belle Etoile ..	Bellouguet, 2nd Ratoons	..	V.A.	80	8·8	..	....	....	93	1·52	14			Fermented Canes.
74	Dec. 1864	Moha	Belleuguet	15	R.A.	77	4·7	1034	·0075	·0052	34·4	·56	8·3	6·6	1·7	
75	,,	La Gaicté ..	Bamboo Plant Canes	14	,,	..	8·4	1063	....	....	91·6	1·5	14·5	14·0	0·5	After great rain.
76	Jan. 1864	Belle Etoile ..	Belleuguet, 2nd Ratoons	..	V.A.	79	10·7	..	....	....	126.	2·06	19	....	....	
77	,,	,,	Guinghan Plant Canes	..	R.A.	80	10·8	..	....	....	129·9	2·12	19	....	....	
78	Jan. 1865	Bel Etang ..	Bellouguet Ratoons.	14	,,	77	8·5	1064	....	....	91·3	1·48	15	13·7	1·3	After great rain.

I have arranged this table so as to show the circumstances in which the results have been obtained; beside the indications furnished by the saccharometer I have placed those given by chemical analysis. Thus the considerable differences shown by these two forms of experiment are easily compared, and in these it will be seen that the juice examined contained in its normal state a certain proportion of uncrystallizable sugar, whilst in other cases, when the juice submitted to experiment was from ripe canes cut at the right moment, the results of chemical analysis agree with those obtained from optical examination, within the limits inseparable from all such investigations.

The average composition of fresh cut cane in general may be deduced approximately from that of juice when the weight of the part experimented upon is known by complete dessication; but the juice contained in the megass being less rich in sugar than what has been extracted, and the washing of the dry cane being a long and difficult operation, it is easier, and at the same time more exact, to have recourse to direct experiment. To determine its composition solely with regard to the water, sugar, and ligneous matter of the cane, I have analysed a number of different species of cane from the localities which represent, in respect of climate, the average where the culture of the cane is most largely carried on, and I give here the analyses which have been made on the canes themselves, all taken under similar and analogous conditions.

(See Table, page 82.)

The sugar is not equally developed in the different parts of the cane: the central, or medullary portion, is richer than the nodular, or the cortical. When the cane is divided, so as to compare separately the knots, the part between the knots, and the outer part of the cane roughly detached, and containing a portion of the medullary part, results are obtained, of which the following example will give a correct idea:—

	Medullary Portion.	Cortical Part.	Nodular Part.
Density of juice at 77 Far. ..	1082	1074	1069
Quantity of Sugar per Cent...	18·4	17·9	17·1

Analyses of Different Varieties of Canes at their Complete Development, Showing the Relative Quantities of Water, Sugar, and Ligneous Substance in 100 Parts of Cane.

Name of Establishment.	Species of Cane.	Water.	Sugar.	Ligneous Matter.
Labourdonnais	Diard	69·8	20·	10·2
Ibid.	Guinghan	68·2	20·9	10·9
La Gaieté	Diard	70·3	19·7	10·
Ibid.	Pinang	67·8	19·6	12·6
,,	Bellouguet	71·6	19·7	8·7
,,	Bamboo	69·5	19·0	11·5
,,	Guinghan	70·3	18·6	11·1
,,	Bellouguet	70·3	20·3	9·4
,,	Pinang	69·	19·8	11·2
,,	Bellouguet	72·9	18·7	8·4
,,	Guinghan	69·7	19·6	10·7
	Bamboo	66·9	21·4	11·7
	Otaheite	70·3	20·1	10·7

This result verifies what I have before said relative to the richness of the juice depending on the pressure employed. The richness would be still more appreciable if the knots of the cane were not always more completely crushed than the portion attached to the bark, which, as I have observed, is the part ejected by the mill the least torn and the most humid.

The canes tainted by the disease which I have described as "*degenerescence*," which has prevailed nearly three years, do not generally contain less sugar than sound canes of the same description or sort. The analyses which I have made in this respect have confirmed the experience of the planters who have used them in the ordinary process of manufacture.

I may add that the canes, when very much affected with the disease alluded to, did not contain a relatively larger proportion of uncrystallizable sugar.

II.—On the State of the Sugar in the Cane.

As I have said, the cane does not contain crystallizable sugar only; in expressing this opinion, contrary to that which at present prevails amongst scientific men generally, I must declare at once that I do not intend by any means to re-adopt the conclusions arrived at by the first chemists who gave us a detailed analysis of the plant. The error which they committed, in admitting the preexistence in the juice of the ripe cane of a notable quantity of sugar liquid, or molasses already formed, could only result from experiments not sufficiently precise, and the theory has been long abandoned. I do not believe—and in this my conclusions accord with the reports of the most recent authors—that there exists in the sound and perfectly developed cane a sufficient proportion of uncrystallizable sugar to be worth notice. But I have arrived at an opinion quite contrary to that usually entertained, when the question is, as to the results furnished by every other part of the plant, except what has been subjected to the prolonged action of the sun's rays, and to the period in the development of the plant when it is examined, and the state of the sugar in different stages of its vegetation.

The better to explain the details on which we are entering, it is needful to mention in a few words the characters proper to the different substances called sugar. The first group of these in which alone we are interested, is formed of those which have the remarkable property of changing by fermentation into alcohol and carbonic acid.

Sugar proper—*i. e.*, cane sugar ($C^{12} H^{11} O^{11}$)—is distinguished from all others by the property it possesses of crystallizing into rhomboidal prisms, and the facility with which it is recrystallized when it has been dissolved in water. Hitherto it has only been fonnd in the vegetable kingdom, and it is only under the influence of vegetation that it has birth.

Glucose, or grape sugar, ($C^{12} H^{12} O^{12} + 2$ H.O.,) is met with both in the animal and vegetable kingdoms, and may also be formed by various chemical processes. It is precipitated in little pappy crystals from a solution in water, when slowly concentrated or left to stand a time by itself. It is less soluble in water than cane sugar, and its taste is only about one-third as sweet. Treated with a hot solution of potash or soda, the glucose becomes oxidised, and gives to the liquid a deep brown colour. Boiled with potassic tartrate of copper, it reduces the metallic oxide, and produces instead an abundant red precipitate. These two re-actions allow us to discover the traces of glucose when mixed with cane sugar. The different appellations of sugar of feculæ, sugar of rags, of farina, of diabetes, are applied to glucose of these different origins.

Uncrystallizable sugar—called also inverted sugar, fructose, levulose,* &c. ($C^{12} H^{11} O^{11}$)—exists in the greater number of fruits, and is found equally formed in the stalks of some plants. It may be produced by the direct action of acids on cane sugar.

Like glucose, it turns brown under the influence of alcalis; it quickly reduces the potassic tartrate of copper. This uncrystallizable sugar becomes modified at the end of a certain time, and is partly changed into glucose, which appears in the form of small crystalline grains. It has sometimes been considered as a composition of glucose and sugar liquid. But though it presented certain physical characteristics of the latter species of sugar, it is certain that it is not always identical in its vegetable organization, and that it is manifested under different molecular states, if not with a composition intimately variable.

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* Gelis gives this formula for levulose, $C^{12} H^{10} O^{10}$; that is to say, an equivalent less of water than in prismatic sugar.

(To be continued.)

CONTRASTS IN JAMAICA.

BY J. W. MITCHELL.

Sir J. Grant is reported to have said in a speech which he lately made, that just before he left England for Jamaica, a friend said to him—"If you can find any two persons in Jamaica to agree upon any subject, send them over to the British Museum as specimens." There was truth in the jest, and the reasons are not far to seek.

Jamaica is not so much an island, as, if one may so say, a congeries of Islands which cohere together, but differ from each other in climate, in soil, and productions, and in their general circumstances more than do many of the islands which are strown along the Caribbean sea at intervals of one hundred miles or more. To come nearer home, Connemara and the corn bearing lands of Wexford, the "laitch" of Moray and the green hills which dip into the sea lochs of Argyllshire, present no contrast so striking as those which are exhibited in an island where it is but a step from fertility to utter barrenness, where a few miles will take the traveller from the cactus and acacia, the vegetation of the desert, to a region of what is called "tropical vegetation," moistened by frequent showers; or from the dry burning plains to mountain paths where the common trefoil, the wild rose, and a plant much resembling the broom, recall very different scenes. Violent and desolating rains, alternate in some districts with periods of no less desolating drought; and cycles of years which are more or less favourable to agriculture, with others which are sadly the reverse. Nor are the inhabitants entirely free from these contrasts, for the usual peaceableness and order of the black population gives place in some parts to turbulence and disorder, either from the fact of those localities having been originally peopled by a more savage tribe of Africans, or from the operation of other and later causes. So, also with the plantations; for while there are districts in which the fertility of the soil and the size of the estates have induced a certain amount of energy and capital to be applied to agriculture, in others the ruinate cane fields in which wild nature is already striving to supplant cultivation, the broken down fences and dilapidated buildings, attest the narrowness of the margin of profit which remains to the planter.

A few years ago when enquiries were being made into the condition of things in Jamaica, nothing so puzzled and perplexed those who were anxious to get at the truth, as the directly contradictory statements made to them by persons who seemed to be equally worthy of credit. The Baptist missionary coming from a poor district where a few small estates, ill-cultivated and exhausted, were struggling desperately to keep their heads above water, spoke eloquently of the wrongs of the negro, of the denial of justice and of the non-payment of the wages due to him, while the planter from a more fertile and prosperous district would assert that justice was, on the whole, fairly administered—that wages were paid regularly every Friday afternoon, or Saturday morning at the farthest—and that the withholding of them without just cause was absolutely unknown. It was the old story of the gold and silver sides to the shield—each spoke of that which had been before his eyes.

A series of letters upon "Jamaica under the new form of Government" have been reprinted from the European Mail in the shape of a pamphlet. The writer of these is evidently very well acquainted with the circumstances of the island, and his conclusions may be accepted. The doing away with the House of Assembly—that "caricature of representative government"—has been an unmitigated blessing, and great praise is due to Mr. Eyre for the promptitude which he displayed in inducing the House of Assembly to act at the moment when men's minds were panic-stricken, and when they were willing to make any sacrifice so that they might escape from the dangers which seemed to be imminent. One week later, and the measure of self-sacrifice, if carried at all, could only have been carried with extreme difficulty.

Of the present Government it is not possible to write otherwise than favourably. Sir H. Storks well said that the Jamaica question was essentially a question of finance; and one great object of the government has been the regulation of the finances of the island, with the result that in place of an average annual deficit of £45,000 (in which sum the interest of the guaranteed debt and sinking fund for its extinction must be included) equilibrium has now been established, while there is, at no very distant date, the unwonted prospect of a surplus, for a measure has lately been passed which, by enabling the island to take immediate advantage of the sum already accumulated as sinking fund for the extinction of the debt, and by deferring the period of that extinction, will cause a direct relief to the amount of several thousands a year. The effect of this is already visible in the island, in renewed confidence; the railroad has been doubled in extent, and there is some hope of its being pushed on still further, new roads are being laid out and made, and bridges built, and, what would appear strangest of all, a few sugar estates out of the many already abandoned are about to be resuscitated.

But there is one class of the population which has suffered from the effect of these changes, necessary as they were, and salutary as they have proved—the mixed race, many of whom had seats in the House of Assembly, which secured to them a certain amount of position and social status, of which they found themselves deprived at one blow. "You and I have been equals," said a coloured gentleman, who had held a seat in the House for many years, to a member of the Council; "but what will be the respective position of our children? Yours will hardly speak to mine." This was perhaps rather too strongly stated, since the prejudices of race and colour are happily fast dying out; but it expressed a certain amount of truth.

With respect to the incidence of taxation, it may not be out of place to give the actual amount paid in taxes during the year 1868, by an estate cultivating a little over 300 acres in canes.

Import Duties on Estate's Supplies			Export Duties on Sugar and Rum.			Duty on Rum Consumed on Estate.			Land and other Taxes.			Immigration Tax on 33 Coolies.		
£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
43	12	0	165	4	0	12	10	0	35	0	8	49	10	0

Of the export duties, one half are imposed for purposes of immigration. The proportion, therefore, would stand as follows:—

	£	s.	d.
Taxes for general purposes	173	15	6
,, for immigration	132	2	0

In the pamphlet of which mention has already been made, the following figures, "taken from the statistical tables for 1866," are given:—

	Total Value, Imports and Exports.	Expenditure.	Proportion of Expense to Imports and Exports per cent.	Population.	Proportion of Imports and Exports per head of Population		
	£	£			£	s.	d.
Jamaica	2,183,694	404,078	18½	441,264	4	18	11
British Guiana.	3,701,642	310,878	8½	155,026	23	17	6
Trinidad	1,962,012	203,429	10	84,438	23	4	8

"The above figures," says the writer, "are extremely significant. They exhibit to us Jamaica, possessing every advantage of climate, natural resources, and population, hopelessly beaten in the race." There is, perhaps, something a little vague in the meaning of the words, climate and natural resources. Jamaica possesses in its mountains a climate far more healthy, and natural resources more varied in character than either of the other colonies; but British Guiana is, perhaps, the richest sugar-producing country on the face of the earth; while it is in Trinidad blessed with constant showers that the marvels of tropical vegetation are seen to the fullest.

But in any comparison between the ratio borne by the imports and exports of Jamaica to the taxation and population of the island as compared with other colonies, there are many modifying circumstances which should be kept in mind, and which cause any such comparison stated baldly and without comment to be not quite fair. In the first place it is probable that the food of the people is, in the case of Jamaica, produced to a much greater extent in the island itself than it is in either British Guiana or Trinidad, and it is obvious that this fact would cause a comparative deficiency both in imports and exports—in imports, since the same quantity of imported food would not be required—in exports, because the labour occupied in raising food would not be available for articles of export. There is in the interior of Jamaica a very great extent of land which, owing to the mountainous nature of the country and its distance from the sea, is ill-suited for the production of sugar, and perhaps coffee, while it is eminently suited for the growth of plantains and other vegetables, upon which the negro population mainly subsists. This land, which is easily brought into cultivation, since it wants no other preparation than the felling and burning of the light timber which grows upon it, is in some respects the misfortune of Jamaica. The limestone rock, which in most places rises to the surface, forbids the use of every implement of husbandry except the hoe, and thus a bad, slovenly system of tillage is carried on—a system in which manure finds no place, and the land is gradually run over and exhausted.

Of immigration there is not much to be said, except that it is of vital importance for the well-being of Jamaica. There is scarcely a single instance, if any, of an estate having increased its crops during the last few years without the aid of immigrants. It is true that there exists in the island a population large and apparently redundant, in proportion to the amount of produce exported; it is true, also, that upon the whole the negroes do more work than —their circumstances being considered—might have been expected from them. If every man, or nearly every man, were a freeholder, and often an owner of live stock, such as a horse or mule, besides pigs and goats—if land were cheap and abundant, and if he could live comfortably during the week upon the wages earned by two days' not excessive work, what would be the position of the average English labourer, and what amount of work might he be expected to perform?

The truth is that negro labour is not so much scarce as unsteady and not to be relied on. For example: when the April showers begin to fall in the mountains, many of the people who have been working in the plains leave their employment—very naturally, seeing that they have their own land to attend to. Strict regulations have been lately made for the benefit of the coolies, for supporting them when newly arrived, and for their maintenance when sick; and it is worthy of remark that every industrious coolie contrives to save money, which he often entrusts to the manager of the estate on which he is working. £40 to £50 is by no means an uncommon sum after a few years' residence, and it sometimes amounts to much more. Very few remain permanently in the island, as they generally prefer to return to their own country with their savings. Up to the present time, by far the greater number of the immigrants imported have been Madras or Calcutta coolies. Chinamen, though better labourers, and very tractable when their peculiarities are well understood, have not been introduced to any extent. But there is one evil, the mischiefs arising from which it is hardly possible to over-estimate—the frequent depredations committed (chiefly by boys and young men) upon the provision grounds of those who are more industrious. This evil has now risen to a great height, and calls loudly for a remedy, since it strikes at the root of all industry and good government; for without a reasonable security for property, what government can be called good! A very respectable and industrious black man, when speaking of his losses from robbery, regretted not so much the loss of his property as that his labour should have been in vain. "They steal the provisions," he said, "before they are fit, and when they are of no use to any one." A very sad case has occurred lately. A man who had suffered much from depredations of this sort watched at night with a gun. Intending to frighten, rather than to harm the robbers, he fired, and, as ill-luck would have it, killed a man. This weighed so much upon his spirits that he destroyed himself. If the measures which have already been taken to check these robberies should prove insufficient, it might be worth while to adapt some of the provisions of the "Habitual Criminals' Act" to meet the circumstances. Persons, for example, convicted of robbing a provision ground might, on their return from prison, be subjected to some sort of surveillance, and compelled to show that they were earning an honest living. To the class of negroes from whom these offenders come imprisonment is literally no punishment whatsoever. They receive while in prison plenty to eat, and on coming out they have not in any way lost caste among their fellows.

What field does Jamaica offer for European immigration? The answer is that the experiment has already been tried, and, when tried under proper conditions, with success. There are two settlements of Europeans, numbering a little over 100 in each, in the mountains of the interior—one of Germans, in the parish of W. Elizabeth; the other of English labourers in that of Manchester. Each of these might easily form the nucleus for a larger immigration of the same race. Coffee, ginger, wax, and honey are produced by these settlers, in addition to the corn and ordinary vegetables of the country, and for these they find a ready market, the ginger and coffee being brought up by the traders of the district for exportation. They possess a few head of cattle—horses or mules, besides small stock, and must live in very considerable ease and comfort, even though they do not make much money, though they will do this occasionally, whenever the price of coffee is high. These settlements have now been established for a sufficient number of years to test them thoroughly. It need not be said that any such immigration should be confined strictly to the mountains in the interior, since it is in these alone that Europeans can, when exposed to the weather, live and thrive. Moreover, they have not the same temptations to drink which beset them in the plains—temptations which few English of the lower class are able to withstand. But it seems probable that another, and perhaps a better field for European immigration is opening in the higher ranges of the Blue mountains. Among these it has been found that there are tracts of considerable extent in which some of the more valuable species of cinchona (the red bark, for instance) grow well. It has also been found that the bitter principle exists in the leaves and small branches as well as in the bark of the stem, and therefore that the destruction of the tree may not be necessary for its collection. It seems to be of rapid growth, and can be propagated with as much ease as the coffee-tree. The island Government are in this matter the pioneers, and have now many acres under cultivation, though the trees are as yet quite young. The crop is believed to be of great value, and as the climate is not merely temperate, but even cold in the higher parts, it would seem to be singularly well adapted for European settlers. There is also another class who might with great advantage to themselves take up their residence in Jamaica—men with delicate lungs who possess some little capital. These would find on the elevated limestone platforms and cattle farms of Manchester and W. Anne a pleasant occupation, and a climate which is very favourable in cases of lung disease, being equable, and removed from either extreme of heat or cold.

As regards the future of Jamaica, it is gratifying to learn that the man who is the most competent to form an opinion has pronounced favourably; but its prosperity must arise from the concurrent development of all its resources. Irrigation, which is greatly needed in some districts, has only been attempted as yet, and it now remains to carry it out on a greater scale wherever it is practicable. There are spots which would appear to be suitable for rice grounds, and one near Kingston has been pronounced to be so by a good authority; but in this matter everything has to be done, and the unhealthiness of the work is much against it. Probably the only people who could undertake it would be Chinamen from the southern provinces. In the production of sugar no great increase can be expected; the good land which is suitable for the purpose is very limited in extent, and it is from the consolidation of estates and from improvements in cultivation and machinery that good is to be looked for. Anything like a general resumption of abandoned sugar properties is very improbable, and, were it attempted, could only end in disaster. The day may come when a class of negroes more educated, intelligent, and industrious than the present race will undertake the task with success, and when the day does come the prosperity of Jamaica will be assured.

RESEARCHES ON THE INFLUENCE OF MANURES UPON THE SACCHARINE RICHNESS OF THE SUGAR CANE.

BY M. J. KRAJENBRINK.

From the "Journal de l'Agriculture des Pays Chauds."

(Continued from page 41.)

From the results of my experiments I am led to form tho following estimate of the value of the different manures used.

Guano maintains its established reputation as specially favourable to the growth of the cane, and I recommend its employment along with oil cake, as the union of these with ashes has given the maximum result in my experiments. This I attribute, in the first place, to the direct action of guano, which is very rich in azote upon the young plant, which thus receives a great impetus in the early stages of its growth. All the ammonia in the guano is soon volatilized or absorbed, and then the plant which has become strong draws fresh nutriment from the oil cake which by this time is decomposed. Thus the plant is furnished with ammonia and with a large amount of carbonic acid. The ashes, the mineral portions of the guano, and the oil cake supply an abundance of carbonic, silicic, sulphuric, and phosphoric acids, together with their bases.

By adding lime we obtained a less return than by omitting it, whilst, in our first experiment just the contrary was the case. It is important that this point should be cleared up by new experiments; nevertheless, it is easy to comprehend the cause of this apparent discrepancy. It must be owing to the too free use of alkaline substances, the tendency of which is, as is well known, to promote the disengagement of ammonia from organic bodies, and thus, as in this case, a greater proportion would be lost than if the liberation had taken place more gradually, all the efficacy of the manure is not utilised. We see from this that great care is necessary in the use of alkaline substances, especially in the employment of *lime* in conjunction with manure so rich in azote as is guano.

There is no reason why the use of such manures should be avoided, as they contain ingredients very useful in the formation of the sugar cane, but it is better to use them separately. The ashes or the lime should be spread on the land a month at least before the planting, and should be buried in the trenches which the cane plants are hereafter to be placed, and later on still the manures nitrogenous are to be spread. The dry blood from France is a manure which acts very rapidly, but because of its high price it cannot compete with guano or oil cake. It can only be used with advantage when neither of those two are to be procured. I have found that it attracts great numbers of swine and dogs on to the new plantations, though this may easily be prevented by the admixture of a small quantity of guano, the smell of which is very obnoxious to pigs and keeps them away from any plantation on which it has recently been used.

The efficacy of farm yard manure, of scum, and the residue of the coppers, has long been established and needs no confirmation, planters therefore cannot be too assiduous in their use. In order to make use of the scum and the residue, the following method is recommended as the result of several years experience.

Near the land to be manured, dig some rectangular trenches about 16 yards by 8 yards and 2½ feet deep, the bottom being slightly inclined to the centre. Fill this trench with straw, or any other dry vegetable substances, chopped up and partly decomposed, over this a layer of ashes 2 in thickness may be spread, making the whole about level. The scum and residue from defecation is allowed to drain into these trenches, if too stiff sufficient water is to be added to make it run. To bring this scum, &c., to the place a little cart is used very firmly made and with very low wheels, which carries a tub or cask say of 100 gallons and having in the under side a hole stopped with a wooden plug. The residues of manufacture are collected in this tub as they are made at the Factory, and when full it is taken to the trenches and emptied, the liquid being allowed to flow out in such a manner as to be equally distributed over the grass, ashes, &c. When the dry refuse becomes saturated, fermentation commences and forms humus. The saccharine nitrogenous matters very readily decompose, giving out a very disagreeable odeur, succeeded by a sour smell from the fermentation of the vegetable debris collected in the trench. On account of these exhalations the process should be carried on as far as possible from any dwellings.

When the mass has sunk sufficiently, fresh dry vegetable matter is put in and covered by the liquid residues as before, the process being continued till the trench is full. During the season about 700 tons of excellent manure may be made by filling four such trenches as above described. The manure should be kept a year before being used, in order that the acetic acid which is formed by the transformation of the organic vegetable matter into mould may have time to evaporate, for although a portion of this acid combines with the ammonia which is liberated, and with the alkali of the ashes there still remains sufficient in the free state to injure the plants. The best criterion as to whether the manure may be used, is to open the trench, when if the sour smell is no longer perceptible, but on the contrary the exhalations have the odour of stable manure, or vegetable mould, the manure may safely be used. It is then brought to the planting ground and spread in the furrows of the preceding crop. The land is then ploughed over and allowed to remain untouched for some time.

In level land where no furrows exist they must be made, the usual distance left between them for planting and the manure laid in them. About 40 or 50 loads (2 oxen) is the quantity needful for an acre of land, and its effect continues for three years, during which time one crop of plant canes and two of rattoons are obtained.

Guanine (an artificial manure from Rotterdam) is again proved to be of little value, and I persist in my previous denunciation of it. It must, however, be conceded that it does sensibly increase the saccharine richness of the canes, either when used alone or mixed with ashes, which effect is not discernible by the use of ashes alone. To inquire to what elements in the guanine this increase of saccharine may be attributed would be to enter on a new field of investigation. As a matter of opinion, we should attribute this effect to the phosphates it contains, the influence of these elements on *cereals* being well known.

In concluding these observations, I must express my desire that experiments of this kind may be made more frequently, the conclusions to be drawn from them being often of great practical benefit. The conclusion which may already be drawn from my labours is that it would be possible, by a more abundant use of manure, to double the produce *we obtain from the cane.*

From a comparison of M. Krajenbrink's series of experiments, it appears that the highest yields were obtained by a mixture of manures, on account of the plant being furnished with more complete and lasting nutriment. If these experiments could be prolonged over several years, we should find also that mixed manures produce a more equable yield; whilst with guano, or oilcake, used alone or with ashes, in a few years a rapid falling off would appear, which would end in the exhaustion of the soil.

A mixture of manures has the advantage of uniting matters which decompose more or less readily—thus ensuring to the plant more regular nutriment, and preventing the danger of that rank vegetation (sometimes induced by guano), in which the canes appear very luxuriant but are poor in sugar, for the reason probably, that the carbon is devoted to forming the green and fibrous parts of the cane instead of the sugar in its cellules.

As regards the saccharine richness of the cane, it is apparently fostered in a particular manner by ashes. The proportion of phosphates in guano and oilcake not being very large, we cannot distinguish what part they may have had in producing this result. We point out as a significant fact, that canes grown *without* manure are rich in sugar; and we may observe that M. Dubrunfaut formerly reported that the same thing was observable in beet-root grown on very poor land. Among the numerous experiments made in Germany, on the development of sugar in the beet, it has often happened that the produce of the unmanured part has yielded a greater proportion of sugar than that in which alkaline or nitrogenous manures had been used. The increased yield of sugar is shown to be constant under the influence of phosphates, and this effect is much less apparent on the addition of alkalies and nitrates.

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The object of the simultaneous cultivation of the same kind of plant with different manures is plainly to show the possibility of discovering which produce the largest yields. This is the principal point. But it is important to take into account the specific value of the product, whether it be a cereal, or a radicle, a textile, or a dye that is experimented on. With a plant like the sugar cane, from which the product is extracted by a long process, it is more important than in the case of most other cultivated plants, to examine its internal composition, for it is possible that the results obtained may be in opposition to those based simply on the proportion of sugar. For instance, two pieces of land, one cultivated with guano, the other with a mixture of oilcake, ashes and bone dust, it might happen that although the canes grown with the latter were richer in sugar than those of the former, still the greater weight of canes produced by the guano might warrant us in expecting a larger quantity of sugar on the whole. But if in the manufacture more water is evaporated from it, and it contains a larger quantity of azotic and gummy matter, as well as salts, which will cause the formation of a greater quantity of molasses, then we may find it more advantageous to manufacture from the canes grown with the mixed manure, notwithstanding that their aggregate quantity of sugar is less than those grown with guano.

Hence the necessity in every examination into the influence of manures upon the saccharine richness either of the cane or the beet,—if not actually to extend it over the manufacture of the sugar, which might often prove impracticable,—not to rest satisfied with merely determining the quantity of sugar contained in the juice, but to analyse it for the constituents which have a strong influence in its manufacture, that is to say, water, ash, including alkaline salts and chlorides distinct also nitrogenous and gummy matters.

To return to the experiments of M. Krajenbrink, which are of so much more importance, as they are nearly the only ones relating to the sugar cane which we possess, we may mention that the favourable conclusion at which he arrives respecting guano, is explained by the abundance of rain which falls in Java. He himself recommends that it should not be used when dry weather is to be expected, *i. e.*, at the commencement or in the midst of the monsoons of the East. After this restriction, we can understand, that in climates where rain is less plentiful, guano should be regarded as less suitable for the cane.

In Mauritius and Reunion, the results of the use of guano with and without irrigation, are widely different; in the first case the soil has suffered much less from "the disease" than in the dry lands where guano has been used without irrigation.

Reference has been made in the foregoing by M. Krajenbrink, to a former series of experiments on manures, we therefore, append a table of the results of these.—*Ed. of the S. C.*

FIRST EXPERIMENT ON MANURES.

		I.	II.	III.	IV.	V.	VI.	VII.	VIII.	IX.
1.	Number of Canes cut	680	680	740	820	800	740	840	860	840
2.	Gallons of Juice extracted therefrom	50·8	64·1	80·6	91·8	95·3	86·3	100·5	100	95·3
3.	Average quantity of Juice per cane (gals.)	·0745	·0945	·1043	·1116	·119	·1163	·12	·116	·113
4.	Number of Canes per acre	7205	7205	7865	8700	8540	7865	8880	9030	8880
5.	Quantity of Juice per acre (gals.)	535	677	850	962	1008	720	1060	1050	1008
6.	Density of the Juice (Gay-Lussacs hydrometer)	1·071	1·057	1·058	1·062	1·062	1·062	1·064	1·064	1·069
7.	Corresponding per centage of Sugar	17·14	13·97	14·19	15·1	15·1	15·1	15·55	15·55	16·68
8.	Lbs. of Sugar per gal., calculated from the above	1·835	1·476	1·502	1·603	1·603	1·603	1·654	1·654	1·783
9.	Degree of polarization of the Juice	96°	73°	74°	80°	80°5//	78°5	82°	82°	89°
10.	Corresponding no. of lbs. Crysd. Sugar per gal.	1·578	1;198	1·211	1·312	1·325	1·297	1·348	1·348	1·477
11.	Cent. cub. of Copper Sol. required	7·5	6·5	6·0	6·0	6·5	5·5	5·5	5·5	5·5
12.	Deduced proportion of Uncrysd. Sugar (grammes)	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01	0·01
13.	Quantity of Glucose per gallon (lbs.)	1·333	·154	·1667	·1667	·154	·182	·182	·182	·182
14.	Total Crysd. & Uncrysd. Sugar per gallon (lbs.)	1·711	1·352	1·378	1·479	1·479	1·479	1·53	1·53	1·659
15.	Total quantity of Crysd Sugar obtained (lbs.)	79·8	76·7	97·1	119·7	125·5	112	135·7	134·2	140·3
16.	Yield of Crystallized Sugar per acre (tons)	·377	·363	·458	·545	·593	·53	·641	·637	·665

Manures employed:—1.—Without Manure.
2.—Ashes.
3.—Guano and Sand.
4.—Guano and Ashes.
5.—Guano and Oilcake.
6.—Oilcake.
7.—Oilcake and Ashes.
8.—Guano, Oilcake, and Ashes.
9.—Ashes in double quantity.

THE GOVERNMENT OF THE LEEWARD ISLANDS.

IN the *Times* of July 30, we read with much satisfaction some of the remarks of Mr. W. Monsell in the House of Commons, in reply to a question by Mr. Adderley, relative to the colonial policy of the late and present government. We reproduce the passage referred to. "The partial consolidation of the Windward and Leeward Islands had not been carried out according to the plan of the late government. The course pursued had been to separate the Windward from the Leeward Islands, one class being exclusively crown colonies and therefore more easily dealt with; and the governor, who had the most skill in dealing with the community of these Islands, Sir Benjamin Pine, was sent to Antigua with instructions to consolidate the four islands under one jurisdiction, and place them absolutely under one government. Among the advantages of this scheme, would be the disappearance of a vast number of useless offices—treasurers, judges, and magistrates, of whom there was a complete staff for each island—the endeavour being to make these islands one, in the same sense as Orkney and Shetland. The whole of these islands were about to be connected by telegraph, and the House would appreciate the actual state of things when he mentioned that four of these islands lay within an area not so large as the county of Norfolk."

Since reading these remarks, we have waited somewhat impatiently for the address of Sir Benjamin Pine, to the Legislative Council of Antigua, for a declaration of his policy. After some delay, Sir Benjamin has spoken, and we think we are correct in saying that the general feeling on reading his speech has been one of disappointment, especially with regard to his mode of dealing with the finances of Antigua. The public expenditure of this island is double that of the period when its sugar, protected from the competition of foreign producers, realized an average price which it can never hope to see again. Many of its estates are abandoned, and the value of others has fallen to one-fourth of their former worth; the population is unhappily decreasing,* the island has passed through several years of almost unparalleled drought, and, to crown this sad story, the cane crop, now nearly reaped, is very deficient in yield, and has bitterly disappointed the hopes of the struggling planters.

The ancient constitution of the island had, it was thought, from the change in the condition of the colony since the abolition of slavery, degenerated into an obligarchy, the peasant population was unrepresented, and a wasteful expenditure was permitted, if not encouraged. In 1866-7, Sir Benjamin Pine, who was acting governor during the absence of Colonel Hill, induced the Antiguans to surrender their constitutional rights into the hands of the Duke of Buckingham, the colonial secretary for the time being. A new form of government was then substituted, in which the power of the governor-in-chief is in reality supreme, not to say despotic, for, through his nominees in the council, he is able to carry out whatever policy he pleases, subject only to the approval of the colonial secretary at home. One of the objects contemplated by the formation of this "paternal government" is thus stated in a despatch from the Duke of Buckingham, dated August 1868. "The Legislatures, as now constituted, may be expected to do much for the well-being and prosperity, and *especially for the financial good government* of the colonies in which they have been established."

The acting governor of 1866-7 is the governor in chief of 1869, and able to pass whatever measures he thinks desirable. Sir

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* The decrease in population is shown by the following statistics :—

Years.	Births.	Deaths.	Excess of Births.	Excess of Deaths.
1860 ..	1298	1344	..	45
1861 ..	1326	1403	..	77
1862 ..	1072	1738	..	656
1163 ..	1407	1734	..	327
1864 ..	1407	1750	..	343
1865 ..	1417	1554	..	137
1866 ..	1353	1310	43	
1867 ..	1531	1403	128	
1868 ..	1378	1517	..	139
	12189	13753	171	1735

Excess of Deaths in 9 years, 1564.

Benjamin Pine has the credit of being a financial reformer, and it might have been expected that he would be anxious to apply some immediate remedy to the present sad condition of the chief island under his control; that he would reduce the estimates to a sum more nearly approximating to their amount when the value of estates was quadruple, and the general ability to pay taxes proportionally greater than at present, or at all events that the temporary taxes would be swept away, the export duties wholly abolished, and that equilibrium would be maintained by moderate curtailment in most departments. But Sir Benjamin Pine is not a financier of the Lowe or Gladstone type. His scheme has certainly one merit, simplicity—MORE TAXES are the words which express its chief characteristic. A stamp duty is to be imposed, the temporary taxes maintained, and the export duty on the staple product, the most objectionable tax that human ingenuity could devise (imposed to meet a special expense,) is to be carried to the general account, although the cost of the cavalry, the payment of whom it was to meet, is to be very considerably reduced. This reduction is one good point in the scheme. The cavalry allowance heretofore £25 per man is to be diminished one half, and the twelve days' drill curtailed to four. But it would have been quite as easy, instead of resorting to half measures, to "reform it altogether." The maintenance of the cavalry has only been a source of expense to the island, and its effect merely to withdraw at times, a number of industrious persons from their occupations, to play at soldiers; other colonies far better able to support it have abolished this species of expensive mummery. At all events, as half the expense is saved, the special tax which supported it, should in common fairness have been reduced accordingly.

The difficulties of Sir Benjamin Pine should not be overlooked, it is much easier to fall into reckless expenditure than to return to moderate estimates, and it is especially difficult to carry out financial reforms in small communities. A host of unnecessary officials could not be dispensed with in a summary manner, without great personal hardship.—At any rate Sir Benjamin Pine will prevent the island getting more deeply into debt, and increased taxation is certainly preferable to increased debt. It is possible that Sir Benjamin may be waiting till he has placed the four islands "absolutely under one government," for the inauguration of his financial reforms. But something in this way might have been done in Antigua, meanwhile. There is nothing unfair in the salaries of officials having some relation to the circumstances of the island, and there is no reason for waiting, in every case, till "vacancies occur" for the "abolition or combination" of "useless offices."

If Sir Benjamin Pine succeed in his almost herculean task of restoring to prosperity the colony committed to his government, it will only be by resolutely cutting down expenditure, and it is certainly a source of regret that he has thought it necessary to begin his *regime* by the imposition of fresh taxes.

In times when the value of property in the island was such that taxes were far less burdensome than now, £20,000 per annum was quite sufficient to meet the exigencies of its government, and no financial scheme which does not aim at reducing the expenditure to this amount, will be regarded with much favour by the planters, or meet with approbation from real financial reformers, who we believe are at last to be found in Downing Street.

MONOSULPHITE OF LIME AS A PURIFIER OF CANE JUICE.

A controversy has lately been carried on in two or three commercial journals (French and English) as to whom the honour belongs of having first introduced the use of monosulphite of lime in the manufacture of cane sugar.

In December last, at a sitting of the Mauritius Chamber of Agriculture, Dr. Icery read a paper on what he termed the "new process" of sugar manufacture by the use of monosulphite of lime. No sooner was this paper made public in France than "MM. Perier, Possoz, et Cail, et Cie," claimed the substance and the process as being included in a patent of which they held the right, taken out for the island of Mauritius in 1861; in which patent they "claim the use of *all the sulphites* (except the bisulphite of lime, which injures the juice) for the defecation and purification of the juice of the cane, the maize, and the sorgho."

Then Mr. Edward Beanes states that he made use of the same material and process (with some addition) in Cuba, in 1862; and Mr. Drum, of Barbadoes, says that many years ago he had tried both monosulphite and bisulphite of lime, and had written on the subject in one of the Barbadoes papers, as far back as 1850.

It is singular that none of Dr. Icery's opponents, or rather competitors, agree with him in recommending the use of monosulphite of lime alone; they either prefer the use of some other substance or of something in addition. Thus Mr. Beanes, whilst asserting that his process is identical with Dr. Icery's, and, in fact, proving that it is so in great measure, denies the *insolubility* of the material (one of the principles essential to its success, according to Dr. Icery), and states that to remedy this, he added, or used in addition, phosphate of ammonia. MM. Perier, Possoz, Cail, and Co., though claiming the patent right to the substance in dispute as being *one* of *the sulphites neutre et peu soluble*, have never promoted its use in manufacture of sugar, and the substance which, as patentees, they supply to planters is sulphite of soda. Whilst Mr. Drum, after repeated experiments, had recommended the very substance which Perier, Possoz, and Co. have omitted from their patent as injurious, viz., the bisulphite of lime, as far superior to the monosulphite.

Having thus briefly adverted to the facts of the dispute, we have no wish to enter further into its merits; but as Dr. Icery, whom all must consider as an authority, has discovered, or brought to perfection, the use of a re-agent of which he *entirely* approves, we purpose to give a translation of that part of his address to the Chamber of Agriculture in Mauritius, in which the process of manufacture is explained.

After dwelling at considerable length on the nature of cane juice and the use of lime in various forms in its defecation, he proceeds—"Setting out upon the hypothesis that in the present state of our manufacture the acidity of the juice might be modified, but ought never to be completely overcome during the greater part of its evaporation, I considered that the best means of acting upon the colouring matter and controlling the principle upon which its decolorization depends was by employing a substance, itself inert, but capable of yielding sulphurous acid, and which should serve to store up this agent, *in the juice*, and gradually to emit it to meet the requirements of the process of manufacture, so that the decolorization of the juice under operation should in fact be performed by its own natural acidity. If, in addition, the substance were to be insoluble, of a light density, and consequently capable of remaining in suspension in the juice, it would become at the same time a powerful defecator, for it would mingle intimately with the albumen directly it coagulated, and would lend to it sufficient consistence and weight to precipitate it on its first appearance.

"Among the sulphites there are certainly several which, by their chemical and physical properties, can fulfil the chief of these conditions; but most of these are not sufficiently procurable to be employed on a large scale. Happily one of them, monosulphite of lime, may be manufactured so readily and at so low a cost, even in Mauritius, that the expense to each factory using it is almost insignificant.

"It is, therefore, this last substance which I have selected, and upon which I have been experimenting on the large scale since the beginning of last year. The difficulty I experienced at that time of preparing daily a sufficient quantity of this re-agent prevented my operating so largely as I should have wished; but, thanks to measures taken at the beginning of the present crop, the results obtained up to that time have been confirmed in the most decisive and satisfactory manner.

"I ought to add, for the benefit of those unacquainted with chemical nomenclature, that, notwithstanding the similarity in name, the sulphite of lime of which I speak is entirely different from that which forms the basis of Melsens' process, for, whilst this latter is soluble and extremely acid, mine is, on the contrary, tasteless, without smell, and of the appearance of a fine clear yellow powder. It is of itself apparently inert, and only acquires its decolorizing power as the acidity of the juice renders it gradually soluble, and thus facilitates the oxidation of the sulphurous acid, and thereby the transformation of the sulphite into sulphate. Since this change takes place for the most part at a high temperature, at which the albumen coagulates, this latter, finding itself in presence of a solid substance, permeating equally the whole of the liquid in a state of minute subdivision, unites with it intimately and forms flocks, which, by virtue of their weight, quickly settle to the bottom of the vessel in which the operation is being carried on, and in a few moments the liquor is decolorized and freed from albumen.

"The juice is best treated by this system in vessels heated by steam, and it appears to me that the process is sufficiently complete to prove of very great service to the vacuum-pan system, since the chief drawback to its use, so beneficial as regards economy of fuel, has hitherto been the difficulty of obtaining a thorough defecation of the saccharine liquids.

"Monosulphite of lime need not be used for juice only; syrups may by its means be made to yield a white and grainy sugar, which although not watered at the centrifugal, may yet compete with many good first crystal sugars.

* * * * * * *

"From what I have stated you will see that the principle which governs the use of insoluble sulphite of lime is so to utilize the natural acidity of the juice as to obtain its decoloration, and to use such a substance for this purpose as shall by its physical properties comport itself as a defecating agent. You will observe, further, that this substance, insoluble alike before and after exerting its action, does not itself remain in the liquor, and cannot therefore subsequently prove an obstacle to the crystallization of the syrups. Again, since its action depends entirely upon the acidity of the of the juice, the quantity to be used need not be carefully regulated, as an excess may be added without the slightest ill effect.

"I shall now give you some figures which will set before you in a precise form what is the economy to be effected by this process. Sulphite of lime being prepared simply by adding to chalk or common lime a solution of sulphurous acid, all the cost lies in the price of the sulphur required for the sulphurous acid. Taking the amount of sulphur used during the whole of the time this system has been at work at La Gaiété, and reckoning it on the amount of sugar turned out during that time, I find that 100 lbs of sugar similar to the samples shown you, require, making no reservation for imperfections of apparatus or carelessness of those conducting it, $\frac{11}{100}$ of a lb. of sulphur, that is ·0011 per cent of the weight of sugar. As it is raw sulphur which is used, it is evident that an increase in quality, which cannot be estimated at less than from two to three shillings per cwt., is obtained for an almost nominal additional cost.

"There remains the necessary apparatus, and the manual labour.

"The apparatus which I have set up, not without some trouble, works in so regular a manner that only one man is employed to watch it, who also makes the sulphite of lime; it will be made here at a low price, and, once purchased and erected, there is no further expense about it, so that the only item is the sulphur, which you have seen is little enough.

"I do not wish to weary you by entering into details: to sum up I may say that my process is free from the evils appertaining to those systems which operate with an excess of sulphurous acid, namely, the inversion of more crystallizable sugar than occurs in the ordinary mode of manufacture, and, further, that it is characterised in a high degree by the two advantages which I sought to secure, namely, a good defecation and perfect decoloration.

"The existence of these advantages may be readily verified by you on the establishment where this process is at work and where a few words of explanation will serve to give you a complete acquaintance with the mode of preparing the sulphite of lime and of applying it to the juice or syrups. It remains for me to add that this substance being, like all the sulphites, very unstable, should be recently made to ensure its having the desired effect, and that, therefore, it is well to make just as fast as it is used, otherwise you cancel the conditions most favourable to its action.

"In conclusion, need I remind you that experiments like the one of which we have been speaking may be undertaken by each one of us, as they are not difficult of execution, and that they should be contemplated in view of their future results; that is to say, the economy and the improvement of product, which they may be the means of introducing into our manufacture. I believe that, thanks to your experience, the system at present used at La Gaiété will in your hands become still more practical and useful.

"E. Icery."

THE WEST INDIA AND PANAMA TELEGRAPH COMPANY.

It must be a source of gratification to all interested in our West India Colonies to find that there is every prospect of complete telegraphic communication being established between them and the mother country. We have received the prospectus of a company formed to extend the telegraph, already existing between Cuba and the United States, through nearly all the West Indian Islands to British Guiana and Surinam, with a branch from Jamaica to Panama. From Surinam there is no doubt that before long it would be extended to meet the lines at present existing in Brazil, and from Panama communication will eventually be established with all the South American republics. It is a matter of surprise that the British West Indian Islands have not long ere this had the almost inestimable advantage of a line of telegraph connecting them with the United States and Great Britain and the rest of Europe, for want of it they are in a manner cut off from the rest of the world.

The carrying out of the undertaking will, we have no doubt, inaugurate a new era of increased prosperity, to which it will largely contribute. To all concerned in the sugar trade, planters, merchants, refiners, dealers, telegraphic communication with some of the chief sources of supply, will be a great boon; in fact, all the various interests of the West Indian Colonies will receive undoubted commercial benefit. To speak of the social and political good likely to accrue from magnetic connection would be to venture on a somewhat hacknied theme.

It is not wonderful then that the prospectus of the West India and Panama Telegraph Company should be received with favour on every hand, and as there is almost a certainty of its proving a profitable investment (it can scarcely be called a speculation), applications for shares will doubtless be largely in excess of the number issued. In the consideration that the success of the undertaking depends on the continuity of the nerve through which the electricity will pulsate, and that this continuity may be broken in any place or at any time, it might be objected that the enterprise is not only a speculation, but a speculation of a very speculative kind. The force of this objection is, however, weakened when the cables of a company are numerous and short, and it disappears altogether when we know that shares or cables may be insured against loss or mischief, just as premises may be insured against fire.

The Company propose to raise £650,000, in shares of £10 each, £1 payable on application for shares, £1 10s. on allotment, and the rest by monthly instalments of £2 10s. each.

The Company is forming under the auspices of a direction which includes many names well known in West Indian affairs, and the arrangements for carrying out the undertaking appear to have been in a forward state before any prospectus was issued to the public. A contract has already been entered into with the "India Rubber, Gutta Percha, and Telegraphic Works Company, Limited," for the supply of all the cable needed for oceanic communication, to be made and laid for the fixed sum of £587,000; which, considering that there will be 2,550 miles required, appears to be a very moderate sum, in comparison with the cost of other submarine cables. No undivided length being above 600 miles, neither difficulty nor delay is anticipated in laying the cable.

Concessions have already been arranged for with the Spanish Government for securing to the Company the exclusive rights for 40 years, as far as regards establishing and working the telegraph through Cuba and to Porto Rico, and the connection of these islands with the British West Indies, Mexico, &c., and for acquiring important rights, with subsidies amounting to over £14,000, granted by the colonial governments for ten years.

As regards income, the prospects are very bright, and there is no reason to suppose that the directors have taken too sanguine a view of them. Sir Charles Bright, the engineer of the undertaking, who has recently returned from the West Indies, estimates the probable income from messages, based on the returns of the Cuban line, at £156,000 (which, added to the subsidies already mentioned, makes a total of £170,000), and the working expenses at £20,000, leaving a margin of profit of £150,000. With the prospect of such an income from messages as is estimated it appears to us unnecessary to call upon the West India Colonies for subsidies. The finances of few of the islands are in a very flourishing condition, and it must be remembered that though the Colonies will be the most benefitted by the undertaking, from them, or from the commercial interests connected with them, the income from messages will be derived.

We may add that an "advantageous arrangement" has been made with the International Ocean Telegraph for a mutual interchange of traffic.

THE MOLASSES OF COMMERCE.

By M. Dubrunfaut.

From "La Sucrerie Indigene."

Molasses has always been a residue of the manufacture of sugar, and its composition has always varied with its origin, and with the diverse elements which always aid in its production. We may safely affirm that it has never been an object of special manufacture, nor subjected to the same conditions of quality which characterize the special articles of commerce.

But molasses is merchandize, and as such it submits to certain commercial distinctions which do not take away in any manner its real nature as a residue.

Thus, if it is made in cane (sugar) manufacture, it is called cane or colonial molasses. Cuba produces it in considerable quantity, from whence it occasionally comes to our markets, but only for purposes of distillation, the extraction of sugar from it not being permitted in France. The Americans take the greater part, from which they extract an amount of sugar by the simple process of concentration. This article sold by the colonists of Havana as molasses, that is to say, as the residue of their manufactured sugar, is to the Americans a material for manufacture, and furnishes them, in addition to the sugar, with a new residue which they call molasses also.

This example may shew the different value and meaning of the word molasses, as applied to the residues of sugar manufacture.

In fact, what is in Cuba a residue, *i.e.*, a product considered to be uncrystallizable, is in Philadelphia the raw material for their sugar manufactories, which after having yielded a quantity of sugar more or less considerable, is still called molasses, although the new process it has been subjected to has materially modified its composition. American molasses, in fact is the same as Cuban, less the proportion of sugar which has been extracted. It is less rich in sugar, and contains a portion of mineral salts and glucose. The Osmose or other analagous processes which the science of sugar manufacture is bringing out every day, may yet lead to the modification of the composition of cane molasses, whilst at the same time it reduces its production as an uncrystallizable residue.*

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* We have given up to the Americans the Osmogéne process, which probably facilitates the extraction of more sugar from the Cuban molasses, and thus proportionately reduces the saccharine in their residue molasses. This process may be used by the colonies in connection with distillation, which utilises the liquid from the Exosmose process. The saline liquids may even serve for the irrigation of the canes.

In Europe two distinct varieties of molasses are known besides the Colonial, which are consumed in some countries, as in England, in great quantity. There are beet molasses, and that made in the refineries. Beet molasses is distinct from the molasses made in the refineries which use beet sugar. Refineries which work simultaneously on colonial and beet sugars, produce what is known as mixed molasses. Such, is sometimes the residue of Parisian refineries which use indifferently, colonial or beet sugar.

The mixed molasses of the refineries is distinguished from raw beet molasses by its taste, which is altered by that of cane sugar, and by the presence of glucose or uncrystallizable sugar in greater or less proportions, introduced by cane sugar.

The raw molasses from the beet sugar factories is generally distinguished by the absence of glucose, for it is only exceptionally that it contains any of this product, i.e., when the molasses is from manufactories where the system is imperfect.

Whatever the nature and origin of molasses, its composition is essentially found to be variable. Such is in effect the cause which explains the different formulœ adopted by sugar makers and refiners respecting the saline coefficient, which is now one of the bases of the process of analysis which we have made known under the name of mellassimetry.

Raw sugars are, in reality, combinations of pure sugar with salts and various other matters, which, in the process of refining, detain a certain quantity of sugar under the form of molasses.

This residue, accounted uncrystallizable sugar, takes the formula in the beet sugar refineries, implied in the general analysis of 50 per cent. of sugar and 10 per cent of ash, which produces the coefficient of $\frac{50}{10} = 5$.

If we apply the same method to the analysis of raw sugar molasses, i.e., of molasses made in the manufacture of beet sugar, we find the coefficients very different, not only in different manufactories but in the same manufactory in different years and at different periods of the same year.

In general these coefficients, instead of giving the figure 5 as in the refinery molasses, varies between 3 and 4, i.e., that 3 or 4 parts of sugar are rendered uncrystallizable by the presence of one part of mineral or vegetable salts, of which the presence is determined by incineration. It sometimes happens that these coefficients present greater variations; thus we have found occasionally coefficients of 2·6 to 2·8, where at other times they have been as high as 4. In a table of analysis of a number of raw sugars from various parts, which we have prepared, with the view of determining the average, we have found the mean coefficient to be 3·73, which we have thought of proposing to refiners and makers, but this mean term, which would have clashed with the customs and interests of refiners, has not been admitted.

It is a fact, however, that melassimetry, the only useful base in the assay of sugar, it is a fact, we say, that this base is entirely empirical, because it is founded on an element essentially variable, i.e., on the composition of the residue or molasses.

The impurities of molasses which furnish the saline element are naturally very varied. In the first place there is the distinction between the mineral salts and the organic salts. The well defined mineral salts are the chlorides and the nitrates. These two species of salts, considered as bases of saline coefficients, detain different proportions of sugar. We might probably say the same of organic salts if they were better known and defined. The state of our knowledge of them only allows us to say, with any certainty, that the organic salts give sensibly higher saline coefficients than mineral salts. It is probable also that the salts of lime which, in the manufacture of sugar, are always introduced into the syrups, and, consequently, into the molasses, will give lower saline coefficients than those of salts of potash or soda if they could be separately measured.

In short, the saline coefficients of molasses are, in reality, a combination of numbers; they are the mean of different coefficients and multiples which cannot be determined singly. They are also or may be averages little removed from the truth, and this standard has been accepted by the commercial and manufacturing interests as though it were a most precise and simple and well known element for the regulation of their interests.

One cannot comprehend why commercial practice, which has admitted this empirical base as the regulating element in the value of sugars, has not applied it to the commerce of molasses, to which it is far more clearly and logically adapted, in that the molasses itself would furnish the material. * * * *

NEW PROCESSES OF SUGAR MANUFACTURE.

From the Jamaica Guardian, of June 25th and July 9th we obtain some interesting information relative to new processes of manufacturing sugar. The first has reference to Mr. Espeut's patent machines for curing sugar, one of which has been erected on Guy's Inn Estate. The patentee has aimed at the solution of three difficulties.—

1st—"To separate the feculae from the juice whilst cold, and "before any heat at all is applied to it, rapidly enough to prevent "it fermenting."

2nd—"By evaporating in vacuo he would avoid the formation of "caramel by burning."

3rd—"To separate the sugar from the molasses, in or order to "save those crystals which are now lost in the molasses as it falls "through the bottom of the cask when in the curing house, the "loss by leakage on the voyage, &c."

Mr. Espeut thus describes his method for effecting the first of these.

"In my process of filtration, instead of excluding the pressure of the atmosphere, I utilize this enormous force by making it drive the juice through the filter in its endeavour to restore the vacuum which I create on the inner side of the filter. By this means, I am able to filter any quantity of cold juice in any given time, as the rapidity of my process of filtration depends merely on the size of the filter, and the amount of vacuum obtained on the inner side of it. Juice can be filtered by this means quicker than it can be ground, and instead of the mill having to wait on the filter, the filter must wait on the mill; there is, therefore, no risk of the juice fermenting before it can be filtered!"

A description of Mr. Espeut's method of separating the molasses from the sugar was given amongst the abstracts of new Patents in in last month's "Sugar Cane."

The practical working of Mr. Espeut's patent machines on Guy's Inn Estate, does not appear to have been carried out sufficiently to warrant any decided opinion as to their success.

On the 7th of July, a trial of Knagg's Patent for the improvement and manufacture of sugar took place on Bushy Park Estate.—A committee was appointed to watch the process. When the trial was over, "the party sat down to a magnificent banquet, at which, some fine practical speeches were made."

The following is the report of the committee, whether drawn up before the banquet or after does not appear, but it certainly is rather vague, and by no means conclusive as to the results of "Knagg's Patent."

BUSHY PARK ESTATE, 7TH JULY, 1869.

We, the undersigned, having been appointed a committee to inspect and to examine the working of KNAGG'S SUGAR PROCESS, at a trial of it to day on this estate.

Do hereby state that we have carefully inspected and examined the several parts of the process, and are of opinion That the injection of the sulphurous acid *gas* into the cane juice at the mill appears to be satisfactorily done, but its effects on the liquor we are not in a position to report upon, owing to the want of good clarifiers and the absolute necessity of *subsiders*, which were not to be had for this trial. That the evaporator is decidedly the most effectual, economical, and expeditious mode of evaporating cane juice we have seen or heard of, and as a proof we give the following result:—

The cane juice from the clarifiers on entering the evaporator stood at 8½ Baume, and in five minutes came out at 30 deg. to 35 deg. The cane juice being acted upon by *steam* in the evaporators instead of by fire as in other systems, appears to us to be one of its great recommendations.

Unfortunately, owing to the arrangement of different parts of Mr. Knagg's machinery, which was out of his power to remedy, part of the Estates' works only being at his disposal, we are not able to report upon the value of the granulator. We can, however, state that we believe the economical use of the waste steam from the evaporator for concentrating the syrup, and the injection of a blast of cold air into the drum of the granulator, to be very useful improvements. We are further of opinion that, if copper instead of iron were used for the evaporator and granulator as proposed by Mr. Knagg, that the result would be most successful. In conclusion, we are bound in justice to Mr. Knagg to state that the trial of to-day was carried out under circumstances opposed to the fair working of the process.

(Signed), JAMES HARVEY,
And eleven others.

MEMORANDUM ON THE ESTIMATION OF MOISTURE IN NEW CHARCOAL.

Charcoal is usually purchased by sugar refiners as containing a certain proportion of moisture, and subject to a proportionate reduction in price if the stipulated amount is exceeded. There has been some uncertainty regarding the temperature at which the moisture should be estimated. I have shown, on a former occasion, that the heat of a water bath is not sufficient to expel the whole of the water; and recent experiments have proved that exposure to an open flame cannot be relied on, as it gives most irregular results and usually a greater loss than is strictly attributable to moisture.

The following example shows how difficult it is to drive off the moisture in a water bath. 100 grains of charcoal lost in

Half an hour	5·97 grains.
Three-quarters of an hour	6·22 ,,
One hour	6·32 ,,
An hour and a quarter	6·41 ,,
An hour and a half	6·47 ,,

The sample heated in an air bath lost at

250° F.	6·47 per cent.
300° ,,	6·97 ,, ,,
350° ,,	7·49 ,, ,,
400° ,,	7·49 ,, ,,

Another portion heated to 350° for 10 minutes lost 7·45 per cent, while three portions heated over an argand jet lost respectively 8·55, 8·33, and 8·03 per cent!

Numerous experiments on this subject lead me to recommend that the moisture be invariably estimated at 350°.

William Wallace.

42, Bath-street, Glasgow, 29th Aug., 1869.

RELIGIOUS ESTABLISHMENTS IN JAMAICA.

In the House of Commons on Wednesday, the 11th August, Mr. Mc. Arthur put a question to the Under-Secretary of State for the Colonies, relative to Religious Establishments in Jamaica. In reply,

Mr. Monsell said the Jamaica Clergy Act expired at the beginning of the year. Under that Act a sum of more than £20,000 a year out of the annual taxation of the colony was appropriated to religious purposes. From the census of 1861 it appeared that there were 40,000 of the inhabitants who attended the ministrations of the Established Church, 42,000 those of the Methodists, 51,000 those of the Independents, and 35,000 those of other denominations. Of the sum of over £20,000 a year appropriated to religious purposes, all but £375 a year went to the Church of England. Under these circumstances it had been determined to introduce religious equality into that country, and instructions had been sent to the Governor informing him that her Majesty's Government were of opinion that the moral and religious welfare of the subject races, and not the ascendancy of any particular community, ought to be the object of the Government, and that the Governor ought to avoid the appearance of giving exclusive favour to any religious denomination. No scheme had yet been submitted by the Governor, but they were expecting one by the next packet, which would be founded on the principle laid down in the extract he had quoted.

According to the last Agricultural Statistics of France, in 1862, there were 136,492 hectares, equal to 327,586 acres of land laid out in beet root, the value of its produce being estimated at £3,400,000. The quantity produced is given at 44,267,585 metric quintals.

THE ELEPHANT CANE.

From the *Moniteur de la Reunion.*

WE have often heard travellers speak of a species of cane—a native of Annam—the size of which is marvellous. The Annamites call it, in their picturesque language, Mia-voi—the Elephant cane.

It has been particularly described in a work on Basse Cochin China, translated from the Annamite by the captain of the frigate *Aubaset*, and which has been recently published by order of the Minister of Marine and the Colonies.

We understand from many travellers that the elephant cane attains a height of eleven feet and a diameter of eight inches in six months. It grows in the province of Haytien particularly.

The *Maritime and Colonial Review*, published by the Minister of Marine, &c., confirmed the fact in a statistical paper on Cochin China, as far back as June, 1865. The following is an extract from the article:—

"There are five distinct varieties of the cane—the red cane, the white cane, the green cane, the striped cane, and the Mia-voi Elephant cane, which grows a height of more than ten feet, with a diameter of about eight inches, and is very rich in saccharine."

These accounts are interesting at a period when it is more urgent than ever to introduce new species of cane into cultivation. We suppose the existence of this cane is not generally known here, for no one has spoken of its introduction, or at least no one has undertaken the task. The fault certainly does not lie in the relations, or in the want of means of communication, with Cochin China.

THE DUTIES ON COLONIAL SUGAR IN FRANCE.

The French Colonies La Reunion and the Antilles, enjoy in France a protective drawback on the sugar duties of five francs per 100 kils., conceded in 1851, as some compensation for the abolition of slavery—just as the English West Indian Colonies received twenty millions sterling.

This drawback, granted at first for a short period, but renewed from time to time, expires, unless again renewed, on the 1st January, 1870. Of course the colonists are not willing to lose this protection of nearly a farthing per pound on their sugar. £2 per ton will make a difference in the profits of the central factories of Guadaloupe and Martinique. But neither are the beet root sugar growers of France likely to permit the renewal of this drawback without a struggle.

In the following petition from the beet root interest to the minister of agriculture, the case is fairly stated. We extract it from the *Journal des Fabricants de Sucre*, of August 5th.

"To His Excellency the Minister of Agriculture and Commerce.

'Monsieur le Minister,'

In the law of 7th May, 1864, respecting sugar, article second grants an allowance of five francs for the benefit of the Colonies la Reunion and the Antilles, for a term which will expire on the 1st January, 1870.

From the colonial journals it would appear that an attempt will be made to induce the government to propose the continuance of this privilege which is enjoyed by our foreign possessions.

Full of confidence in the promises which were made to the indigenous sugar industry, on the discussion of the law of 1864, the central committee of the French sugar manufacturers is convinced that the term of the 1st of January, 1870, assigned as the limited of the drawback, will not be prolonged; and in answer to the new complaints of the colonies, they take the liberty respectfully to bring before your notice the following observations:—

There has been a reason for the existence of the drawback for some years, as a transition measure between slave and free labour, but it has always been essentially of a temporary character. Instituted in 1851, it should have ceased in 1856; continued up to 1861, then to 1866, it was then again extended to 1870.

One of the arguments advanced by the colonists at the time of the last law being made was the protection of two francs levied on foreign sugars, indifferently, on their entry into France, and the 'surcharge on the flag' of an equal sum which was levied on sugar imported in foreign ships. Moreover, the colonists instance the disguised bounty in our favour, which resulted, as they say, from the admission of our sugar to the drawback, by the 6th article of the law which is now in force.

These arguments cannot be brought forward again to day, the surcharge of two francs is abolished on sugars the produce of Belgium, Holland, or England, and the 'surcharge on the flag' no longer exists. Further, the international convention with the three countries, has abolished the bounty, and the advantages which were accorded to us in compensation for those possessed by cane sugar.

It is then unreasonable for the colonies to demand the continuance of a state of things energetically repelled and condemned by all the principles of political economy.

The transition state which it was said the colonies were passing through, is long since over, and the rapid development made in late years by the central factories, the magnificent results they have obtained, and the grand establishments projected, or in course of erection, all go to establish, despite affirmations to the contrary, that the colonial industry is on the way to prosperity, and that it does not need aid on account of circumstances which no longer exist, but are matters of history.

We do not think it necessary to particularize here the extent to which the colonies have profited during the last 18 years; but we may observe, generally, that the loss sustained annually by the treasury (for their benefit) is not less than five millions of francs. Their compensation has been great, and is quite sufficient, and the time is come to put an end to a state of things for which there is now no reason, and which weighs heavily on the home sugar industry and on the revenue.

The colonies have found in the commercial liberty which has been granted to them and which has opened to our Antilles the markets of the United States, and to La Reunion those of Australia and India, and in the example of the prosperous island of Mauritius, they have found, we say, in the incomparable richness of their raw material, and in the resources offered them by a favoured climate, and in the new faculties of credit which have been given to them, the necessary elements for combating successfully against all competition.

In fine, 'Monsieur le Ministre,' when we look at the general interests of agriculture and of French industry—the interests of the Treasury and of our colonists themselves, we have confidence that the solemn promises inscribed in the law of 1864 will be fulfilled, and that the term of 1870 will not be protested.

"We are, &c. &c."

[*Here follow the signatures.*]

PURCHASE OF CANES.

Extracted from the "Antigua Times,"

The great success of Mr. Fryer's invention for the manufacture of Concrete promises soon to confer on this Colony all the advantages that we predicted would flow from it. It is now about four years ago, since in a lecture at the Court House he first propounded his scheme and explained the principles of his invention. The problem that he then set before himself has been worked out with unsurpassed energy and skill, and has been such a marvel of success, that it has attracted the enterprise of others, who have invested additional capital in the formation of a Company for the further development of his plans and the extension of his operations. It has come now to be universally admitted that, in the face of the unequal competition with slave labour, and the extended cultivation of the Beet, the manufacture of Sugar in the West Indies, to be at all successful, must be carried on on an extensive scale, and with all the aids of modern appliances—improved machinery, steam, and economy of labour; while experience clearly shows that cheapness of production is best secured by a division of labour. This, Mr. Fryer's project greatly promotes. The want of capital is, as a rule, the great drawback to the prosperity of this colony; and when the sugar grower is forced to combine this occupation with that of the manufacturer, requiring a large outlay of means, he necessarily does both imperfectly, and failure is too frequently the result. The large quantities of canes that Mr. Burns has been already enabled this season to purchase from the small growers, for the manufacture of Concrete at Belvidere, shows how well the whole scheme is likely to take; and we augur considerable advantages to the Island in the extended cultivation which must be thereby encouraged. When we look about the Island and see the large amount of land out of cultivation, we are led to hope that the establishment of these Central Factories will give a great impetus to our agricultural prosperity. Not only will it be a great boon to the small holders of land—persons owning their five to ten acres, who now pursue their industry under great disadvantages, but those estates in the neighbourhood of factories will find it, we doubt not, more advantageous entirely to abandon the *manufacture* of sugar and to expend their means and energies in *cultivation*—improving their lands and rendering them productive as possible. Land will thus acquire a higher value than it at present possesses; abandoned sugar estates will be reclaimed; and new spirit and enterprise infused into our agricultural operations. What Mr. Fryer has effected on a limited scale, is a guarantee of a measure of greater success with a wider range of operation, and from the positions of the persons who are the prominent members of the Company, and the extensive means at their disposal, which, we have no doubt, will be judiciously employed, there is every reason to look forward to the successful realisation of their expectations, to the consequent advancement of the interests of the colony in the promotion of its industry and its agricultural prosperity.

The purchase of ripe canes by Mr. Burns for the manufacture of concrete at Belvidere promises to expand into a large and important business. In lots varying from 15 to 16 tons to 2 or 3 cwts. Something like 315 tons have been purchased—a quantity we are told representing 800 mule carts. Body-ponds, Sweet's, Cook's, Gray's Hill, High Point, All Saints, Folly Byams, and Sea View Farm have all contributed their quota, at distances of from one to six miles. The great drawback of which people complain is the expense of carriage. Something like £250 have thus been circulated amongst these small growers, who are taking to the system admirably, preferring the sale of the raw material to the trouble and risk of getting their canes manufactured into sugar on the old system of shares

AUGUST 19TH, 1869.

TO THE EDITOR OF THE "SUGAR CANE."

DEAR SIR,

I have before me the very interesting letters written lately by M. Buchanan, M. St. Claire, and M. Westerman, on the working of "Fryer's Patent Concretor," combined with the Vacuum Pan, at M. Bogen's factory, Monte Christo, San Salvador.

I have deduced from M. St. Clair's statements the following figures which bring out more clearly, the great advantages M. Bogen has derived in replacing his open trains by a large sized Concretor.

Last year, M. St. Clair says, with two open trains, one of four, and one of five pans, and a vacuum pan, 6ft. 6in. diam. by 6ft. deep; their production was

8,000lbs. sugar per 15 hours, representing 533lbs. per hour. Each clarifier of 390 galls. of juice yielded 500lbs. sugar, which gives 1·20lb. per gall.

The work done represents 6,240 galls. concentrated per 15 hours, or 416 galls. per hour.

This year, with a large size Concretor and same vacuum pan, their production was 15,000lbs. sugar per 12 hours, representing 1,250lbs. per hour.

Each clarifier of 390 galls. of juice yielded 700lbs. sugar, which gives 1·79lb. per gall.

The work done represents 8,357 galls. concentrated per 12 hours, or 696 galls. per hour.

Difference in favour of Concretor,

in juice concentrated per hour..........	280 galls.	67 per cent.
in sugar produced ,, ...	717lbs.	134½ ,,
,, ,, per gall. of juice,	0·59lb. (or 9½oz.)	49 ,,

These figures go to shew not only a large increase in production of sugar from a given quantity of juice, but also the working off in a given time 67 per cent. more juice. These interesting results must be traced in part to the efficiency of the cylinder, which from the waste heat alone increases the density of the syrup from 10° to 12° and delivers it in a dense state, at a low temperature, and without being scorched.

Had I taken M. Buchanan's figures (17,400lbs. sugar in 12 hours) or M. Westerman's (17,400lbs. in 8 hours), the results would have been still more surprising.

It is also worthy of remark that in this case, as in many others, M. Fryer's apparatus has been doing more work than it is designed to effect.

M. St. Clair states that the juice was concentrated in the Concretor from 10° to 33° B.; in other words, 71 per cent. of the water contained therein was evaporated, 696 galls. per hour being the quantity boiled down, 71 per cent. of this is 494 *galls.* The apparatus is sold to boil to concrete 500 galls. of juice at 10° B. per hour, that is to say to evaporate 80 per cent. of this quantity which is 400 *galls.*

M. Bogen's apparatus was therefore doing 94 galls. per hour (23½ per cent.) more than the makers sell it for.

Hoping that these figures may interest some of your readers,

I remain, yours truly,

GEORGE BLAKE OUGHTERSON.

THE NATAL PLANTATIONS COMPANY, LIMITED.

THIS company having recently purchased, on favourable terms, two large sugar-growing estates in Natal, are issuing debentures to the amount of £25000, secured on a first mortgage of the estates. The debentures will bear interest at 6 per cent. per annum, payable half-yearly. The additional advantage is offered of a gift to each debenture holder of free bonus shares in the company, to half the amount subscribed for. Thus, a subscriber for £1000 will receive £500 in free fully paid up shares, so that each debenture holder, though without liability, will have a direct interest in the profitable working of the concern.

The estates are already in full working condition, and the sugars heretofore produced on them have sold for high prices in the colony and in Mincing lane.

The crops for the coming season are in promising condition, and the estimated return for the present year, computed from the probable yield, is about £12000, and the working expenses "placed at a maximum" are calculated at £9500—leaving a margin, after paying interest on debentures—£2100—of £2420 profit, which will pay a dividend of 6 per cent. on the company's share capital of £40000.

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

62. W. T. WAITE, Salisbury-square. *Treating saccharine matters* Dated January 8, 1869.

This consists in the employment of certain neutral insoluble finely divided substances prepared by precipitation, or in the employment of an intimate admixture of an acid compound and a basic compound in such proportions that, when the mixture is put into water or into a saccharine solution, it will form a neutral insoluble finely divided precipitate. The neutral insoluble finely-divided precipitates which are employed for the purpose of the invention are hydrate of peroxide of iron, phosphate of lime mixed with carbon, phosphate of iron, phosphate of lime, phosphate of alumina, and carbonate of iron. Of these, the preference is given to hydrate of peroxide of iron, and to phosphate of lime mixed with carbon, as it has been found from practice that they give the best results. To manufacture an insoluble precipitate of phosphate of lime mixed with carbon, the process is preferably as follows:—The inventor takes, say 100 parts by weight of powdered animal charcoal, 50 parts of sulphuric acid, and sufficient water, say 1,500 parts, and mixes them, allows them to stand for a time, and then adds about 26½ parts of lime, stirring the whole well together. The phosphate of lime which was in the charcoal is formed into an insoluble finely-divided precipitate. After it has been washed and allowed to settle, the water poured off this precipitate is ready to be put into the saccharine solution for the purpose hereinbefore stated, or the precipitate may be partially dried, and then added to the saccharine solution. Instead of animal charcoal, any other source of phosphate of lime, such as coprolite, apatite, and guano may be employed, but when any of these last-named substances are used the product is phosphate of lime unmixed with carbon. Instead of sulphuric acid, any other acid, such as hydrochloric, which will render the phosphate of lime soluble, may be used; and, instead of lime, any other base or alkali, such as alumina, oxide of iron, or soda, which will make a finely-divided precipitate, may be employed. In preparing any other finely-divided precipitate, a solution of the base or any soluble compound of the base is taken and precipitated by a solution of the acid or any soluble compound of the acid.—Patent completed.

164. A. M. CLARK, Chancery-lane. *Refining sugar*. (A communication.) Dated January 18, 1869.

The mode of treatment forming the subject of this invention is based on the decomposition of the molasses by an energetic acid contained in alcohol, but in such a diluted condition that the sugar may remain in solution, while, instead of precipitating it by means of acetone, ether, or other agent, the sugar is obtained direct by crystallization. The following is the mode of operation:—The inventor takes 1cwt. of spent molasses, marking when cold 45 deg. Beaume, and about 20 gallons of alcohol at 85 deg., with the addition of about 5 per cent of sulphuric acid. The alcohol used may be more highly concentrated, but in this case the suitable apparatus containing a stirrer for a few moments when it becomes perfectly homogeneous, and is then filtered in order to separate the mineral salts formed. In this condition the alcoholic liquor, containing on the one hand the sugar in solution, and on the other the acids displaced by the energetic acid employed, retains the sugar, which remains dissolved in the alcohol, marking 85 deg., the latter being diluted by the whole of the water contained in the molasses.—Patent completed.

235. H. W. and R. LAFFERTY, New Jersey. *Sugar rectifier*. Dated January 25, 1869.

This relates, first, to improvements in the mode of supporting the spindle carrying the drum or basket of a suspended centrifugal draining machine, viz., placing and securing an encircling hollow nut or flanged cap in an inverted position upon said spindle, and receiving and supporting the projecting edge or rim of this nut or cap upon one or more washers in the bottom of an annullar oil cup encircling the spindle, but secured to and resting upon an independent hanger, bracket, or other supporting device arranged therefor. The spindle thus supported and suspended, revolves upon bearings submerged in oil, so that the friction thereof is consequently reduced to the lowest degree. Patent completed.

246. C. GIL, Paris. *Sugar*. Dated January 26, 1869.

The inventor has observed that when limiting the acid to small quantities, instead of its being prejudicial it produces great advantages in the colour, taste, and easy draining of the syrup, and even by changing it into crystallizable sugar. This observation has led him to employ an acid process, a method of proceeding entirely different from those used in the manufacture of sugar, and permitting him to obtain new and very advantageous results, viz., to produce directly from the beet root juice white manufactured masses having an excellent flavour, and, above all, giving loaves which drain easily and are perfect, as well as regular results, which cannot be obtained by an alkaline or neutral process.—Patent completed.

SUGAR STATISTICS—GREAT BRITAIN.

To 21st August, 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	22	1	2	9	34	58	71	6	11	36	124	152	69	8	12	34	123	119
British East India	6	2	..	..	8	5	8	3	..	..	12	3	8	5	..	..	12	7
Mauritius	3	..	..	..	3	4	6	1	5	4	16	31	10	1	5	5	20	34
Cuba	11	4	1	15	31	36	13	9	15	39	76	85	8	7	14	36	65	64
Porto Rico, &c. ..	3	2	..	..	5	9	3	7	1	1	12	14	2	6	1	2	11	8
Manilla, &c.	39	7	1	1	48	37	21	13	1	2	37	27	12	16	1	1	30	30
Brazil	1	14	2	2	18	22	1	25	10	13	50	48	1	27	9	15	52	42
Beetroot, &c.	1	..	..	1	2	1	10	3	1	10	24	29	11	3	1	10	25	34
Total, 1869 ..	84	32	5	29	150	172	133	68	43	106	350	390	121	72	42	102	339	338
Total, 1868 ..	79	45	7	40	22 decrease		142	75	41	132	40 decrease		129	67	39	104	slight increase	

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, JUNE 30, 1869.

	1869.	1868.
United Kingdom	100	99
France	55	66
Holland	55	49
Zollverein	10	4
United States	156	91
Cuba	78	94
Total	455	402

CONSUMPTION IN EUROPE AND UNITED STATES FOR YEAR ENDING JUNE 30TH.

	1868-9.	1867-8.
Europe	1233	1174
United States	392	406
	1625	1580

STATE AND PROSPECTS OF THE SUGAR MARKET.

The market during the past month has been quiet, presenting slight fluctuations in value. At the beginning of the month prices were rather in favour of buyers, but as imports has continued small this depression was merely temporary. The inquiry for West India and other raw sugar has been sufficient to produce a decided firmness in the market, although there is very little demand from Greenock; refiners there being again short of water; chiefly from this cause an advance of 1s. to 1s. 6d. per cwt. has taken place during the last week in the price of crushed and pieces.

Notwithstanding that buyers generally operate with caution, there is not much probability of lower prices prevailing at present. The general stock of sugar is certainly in excess of last year, but this excess is entirely in the United States of America, and the difference is less than it was a month ago. Deliveries, which had fallen off at the commencement of the year, have lately been more than ordinarily large, and in the United Kingdom show a slight increase up to the present time over those of the same period in 1868. It is true that there is a prospect of considerable increase in the production of Beet sugar this year, but it should be remembered that this cannot practically affect the market for some time to come.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

THE

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REGISTERED FOR TRANSMISSION ABROAD.

No. 3. OCTOBER 1, 1869. Vol. I.

☞ The writers alone are responsible for their statements.

IMPORTED LABOUR.

By a West Indian Merchant.

Forty years ago, slavery was almost the invariable accompaniment of sugar cultivation. Abolished first by the English, and subsequently by the French, Dutch, and American nations, it survives only in the Spanish and Brazilian possessions. In the former, its tenure is most precarious, and once put an end to there, it may reasonably be expected that the "peculiar institution" will not long remain the invidious distinction of the Empire of Brazil.

In the Western Hemisphere, the cultivation of sugar has everywhere at its commencement been carried on by slave labour, and the experience of the last thirty years, has shown that in all but exceptional cases, where the option lay between starvation and labour on sugar plantations, the slave population has gradually withdrawn itself from this industry. The process in some cases has been rapid, in others gradual, but it has, save in a few small islands, been invariable, and is still going on. In eastern waters, Mauritius is a pertinent example of the same state of things.

Eliminating then Barbadoes and one or two small colonies from the question, it may be broadly stated, that the negro population settled in the several sugar producing districts in and adjacent to the Gulf of Mexico, is utterly unreliable as a labour market, and the writer is satisfied that until all interested in that industry are thoroughly convinced of this fact and act upon it, the cultivation and manufacture of sugar cannot be placed on a sound and stable basis. Mauritius, British Guiana, and Trinidad, may be quoted as salient examples of the success of the policy of importing labour, and it is to be noted that every colony which has once set about immigration on an adequate scale has persevered in the effort, and the only difficulty experienced is, to obtain a sufficient supply of hands for the ever increasing demand.

Those colonies in which, from their sparse population, the question assumed the most serious proportions on the abolition of slavery, were naturally the first to take the lead in the movement. It would, perhaps, have been well for others, and more particularly Jamaica, had they sooner followed in their wake. Under the enlightened policy of the present Governor of Jamaica, Sir J. P. Grant, immigration has been renewed in that Island, but many planters are disposed to hold back, to cavil at the regulations put forth, to dread the expense, and even to doubt the efficiency of the Coolies, and the necessity for their introduction.

These feelings are more often found among the proprietors of small than of large estates, and have in their case much justification; in fact, imported labour will hardly answer except on a somewhat extended scale, the dead expenses are too heavy, the regulations necessarily laid down to prevent abuses of the system entail obligations which are both costly and seem invidious when applicable to a small number only; but nothing seems to the writer more certain than that small properties are doomed; that sugar cultivation if it is to be carried on as at present, so as to combine manufacturing with agricultural operations, must be on a scale of some magnitude, differing as to the minimum, according to the varied circumstances of the several districts in which it has been established.

It is evident from the circumstances under which the cultivation of the cane is being introduced into new regions, and from the absorptions, amalgamations, extensions, and too often the abandonment of estates in old colonies, that, as originally settled, they were not placed on a sound commercial basis, the cause for which, as is well known, is not far to seek, viz:—the system of protection under which they were nurtured and alone flourished.

It is earnestly to be hoped that none of the new race of proprietors (and they are a large and increasing body in our old colonies) will waste their labour, energies, and capital, in striving to make a competence out of what can at best barely supply the means of existence, while too often the hardly earned savings are swallowed up and altogether lost.

To those, however, who are either as proprietors or agents, concerned for estates, which, either are at present sufficiently large to give an adequate return for the capital invested, or are capable of being extended with a sufficient supply of labour, the writer would strongly urge the question of imported labour, as one well worthy of their very careful attention.

Immigrants supply to the planter a nucleus of available force, which can be applied wherever needed in the different branches of his industry, a force certain and continuous, which enables him to regulate to a great extent the rate of native labour, and ensures him against the risk of the loss, at a critical period, of the results of his toil. And even in cases in which no difficulty is at present found in obtaining sufficient resident labour for the ordinary work of an estate, it is to be remembered that there is no certainty of such a state of things being continuous, and, moreover, that the limit of results in the productive powers of a sugar estate may, roughly speaking, be said to be the amount of labour available, to say nothing of the capabilities of extension which most possess. Where is the planter who can say that he has as much *reliable* labour as he could wish for, to give full development to his property?

It is difficult to estimate the effect on the value of property in the British colonies which would result from the labour question being once placed on a sound and stable basis. Capital would be attracted, estates would once again yield something in proportion to their true value, and sugar cultivation would receive an impetus, the extent of which it is difficult to realize.

And here perhaps it may not be out of place, to give a few hints to those who having charge of immigrants, have not yet experience to guide them. It is on the first arrival of a fresh importation that the greatest care is requisite. If not carefully attended to for the first three months until they get acclimatized great mortality often takes place, or they become debilitated and contract diseases which prevent their ever being healthy and useful labourers. It may safely be said that especially at first, and in a less degree subsequently, it is the worst economy to stint the hospital expenditure. Frequent medical inspection is of great importance as "shamming" is one of the faults of the coolie, while if anything is seriously amiss, the sooner it has attention the better for all parties. When the labourers here become accustomed to their position and new life, it is well to allow them as much freedom as is compatible with due supervision. Where tho locality admits of it, the privilege of building their own cottages on an alloted piece of land is highly prized, and it is found that as a rule, the men are more healthy in the mud-wattled huts they build for themselves, than in the range of barracks constructed on purpose for their accommodation. The privilege of keeping a cow as a reward for good conduct is highly thought of, and such little favours do much to attach the labourer to an estate, and to induce him to reindenture himself, or settle on the property. It need hardly be pointed out that this is the object the employer should keep in view.

Above all it may be urged on those employing labour, not to scan with too critical an eye the regulations laid down from time to time, for the care of immigrants. It is to be remembered that the movement is watched on all sides by zealous not to say hostile eyes, that the Colonial and Foreign Offices at home, no less than the Local Governors, have often a difficult part to play, and moreover, past experience shows, that such is human nature, that even self-interest cannot always be trusted to provide properly for dependent labourers. It will be found in practice that the letter of the law is gladly relaxed, where it can be satisfactorily proved that tho relief sought is for the real benefit of those concerned.

In estimating the importance of the introduction of foreign labourers into our Colonies, the fact should not be lost sight of that they add very materially to the security of our tenure, and diminish to a great extent the probability of a native uprising being successful. That this is a real danger, in the West Indies and in other countries where the coloured population largely exceeds the number of Europeans, it would be foolish to deny or shut our eyes to. Past experience proves it and no one really conversant with the state of society there, can doubt that it is at least an element of danger. Few also would be found to deny that the apprehension of a possible rebellion is one of the causes which tend to divert capitalists from seeking employment for their funds in that direction. The fact, however, of there being on every estate a number of able-bodied men ready, under the supervision of Europeans, to resist any insurrectionary efforts, is a great element of safety, and the more diverse the sources whence immigrants are drawn, the greater the security; for it is quite certain, that however little love there may be towards the European in the breast of the Indian or Chinese Coolie, there is far less towards the Negro, and as this is reciprocated with interest by the latter, and the foreigners would certainly be the first victims of a successful outbreak, (a fact fully appreciated by these people,) self-interest, no less than inclination will range them on the side of order. Perhaps this point has not excited the attention it deserves, but it is surely well worthy of consideration.

If it be conceded that immigration is of vital importance to the interests of the sugar grower, the question of the probable available supply is one which demands attention.

Already, the Portugese from Madeira who were so useful in British Guiana in the early period of need, are exhausted as a supply. The same may be said of the liberated Africans.

Nor is it to be denied, that there are signs that India may not in the future prove the inexhaustible recruiting ground which we have been accustomed to consider it. Already the cry is being raised there, that the labour which might be profitably employed in the tea plantations of Assam, or the coffee estates of the Neilgherries, (to say nothing of the numerous other industries in the course of development throughout that vast country) is being diverted to foreign lands; and it is far from improbable that sufficient pressure may be brought to bear on the Indian Government, to induce it, if not exactly to prohibit, to throw obstacles in the way of the movement.

But, fortunately, should the Indian market fail, there is in the vast empire of China, an almost unlimited supply of available labour. The Americans are already seriously turning their attention in that direction, and we hear of contracts for thousands of Chinese being entered into to supply the wants of the Southern States. No one who has witnessed what the Chinese immigrants are, can doubt their value, and therefore it is no slight comfort to think, that if other resources fail, we have this immense supply to fall back upon. The great drawback hitherto has been the expense attendant on procuring Chinese, and this has lately been further complicated by the stipulations entered into between that Government and the English representative. In all probability however, the Pacific will in a few years time be the great highway for emigrants from Asia to America, aud with the multiplication of routes across the isthmus and mainland, it may reasonably be anticipated that the expense of conveyance will be materially reduced.

It is curious to speculate on what may be the result of the mixture of the varied races that have been, and in all probability will be, poured over extensive regions of the Western Hemisphere. Amalgamation, though slow, must eventually take place, and a nation, the component elements of which should be made up of the physical power of the negro, the natural beauty and docility of the Indian, and the intelligence, hardheadedness and energy of the Chinaman, might be expected to hold its own against all comers. If, as ethnologists tell us, Europe was peopled by the Aryan race, it will be somewhat remarkable, should the descendants of that ancient stock in their latest developments westwards, be met face to face by a stream of population setting in from those regions whence they themselves had their origin. And it is surely not too much to hope that a great moral purpose may be served by the contact of Asiatics with European civilization, and that ultimately and indirectly, it may tend to open up those vast regions and pave the way for the introduction of a more enlightened knowledge, a nobler life and a purer faith.

RESEARCHES ON THE JUICE OF THE SUGAR CANE,
And on the Modifications to which it is subject during Manufacture, in the Island of Mauritius.

From the French of Dr. Icery.

(*Continued from page* 85.)

The action which solutions of the different sugars we have passed in review, exercise on polarized light, furnishes precise results for distinguishing between them, and it is at the same time the more sure and precise means of determining their relative quantities, in a liquid which does not contain other elements equally capable of acting on polarized light. The modification of polarized light by different sugars is more or less marked, and is not exercised always in the same manner. Cane sugar, crystallised glucose, lactine, trehalose, melitose and melezitose, divert to the right the plane of polarization. Of all substances, trehalose possesses the greatest rotatory power, after it come melitose, melezitose, cane sugar, lactine, and glucose.

Acids tend to modify in an opposite direction the rotatory power of cane sugar, which then diverts to the left the plane of polarization. Glucose does not submit to any change in this respect, under the influence of acids. Like inverted cane sugar, the liquid sugar of acid fruit diverts to the left the plane of polarization.

These important results, furnished by optical analysis, are powerful aids in elucidating certain questions relating to the presence and formation in vegetable organizations of the divers species of sugar, which I have enumerated. The saccharometer and ordinary chemical analysis, employed concurrently, have already led, in this respect, to most valuable results.

In all the researches which I have undertaken, with a view of determining the nature and quantity of saccharine which juice contains, I have constantly had recourse to optical examination simultaneously with chemical analysis. The agreement of the indications furnished by these two methods in certain cases and their disagreement in others, have led me to conclusions which appeared to me of some interest, as much from a scientific point of view, as in regard to the ordinary practice in our colonial sugar manufactories.

I shall not here enter into detail of the numerous experiments I have made on the subject, a great number have been recorded in the tables given before, the explanations accompanying which, are sufficient to render them quite intelligible. I shall content myself with noting the results which I have obtained, of each of which it is easy for any one to verify the exactitude.

1.—When the cane of whatever species and wherever grown has reached maturity after regular growth, *i.e.*, at the period when it has ceased to increase, and when its different parts seem neither to gain nor lose, a period easily distinguished by the planter, it contains scarcely anything but crystallizable prismatic sugar, through the entire portion of what may be called the body of the cane, which extends from the first knots above the root to those immediately under the green leaves, still attached to the stem. The quantity of inverted sugar which the juice then contains is extremely small, rarely more than $\frac{1}{250}$ part of the weight of the juice, or $\frac{1}{50}$ part of the weight of prismatic sugar. I have under the most favourable conditions found only $\frac{1}{75}$ part of the sugar to be inverted.

Optical examination in parallel cases directly after inversion of the liquid, furnishes results which show that at a certain temperature, the rotatory powers of crystallizable sugar and of levulose are generally alike, or that they differ only in an insignificant manner.

This small quantity of uncrystallizable sugar is variable, but constant when the examination is made of the juice from the entire portion of the plant indicated. It is augmented sensibly when the juice is obtained from between the knots near the head of the cane, and diminishes according as the juice is obtained from near the middle of the body of the cane, where it is generally inappreciable.

2.—If instead of examining the body of the cane, the portion surrounded by green leaves, and protected from the rays of the sun is operated on, the juice extracted is found to contain a considerable quantity of uncrystallizable sugar, which may be estimated at one-sixth of the weight of the crystallizable sugar in ripe canes, and in those unripe at one-third of the weight.

When optical analysis leads to results opposed to those of chemic, and things worthy of attention lead to new researches, those results are not always indentical as regards the quantity of sugar given by chemical processes. It produces, then, under certain circumstances dependent on the age of the plant and the activity of its vegetation, discrepancies which can only be explained by the notable differences in the rotatory power of the uncrystallizable sugar, which exists in the juice of this portion of the cane.

The saccharine liquid always diverts the plain of polarization to to the right; but after inversion, the notation to the left is rarely in proportion to the entire quantity of inverted sugar contained in the liquid, and it is generally expressed by a lower figure than that which should be given. Amongst other instances which I could cite, the following will give an idea of the difference which the figures may show:—

Juice extracted from the upper extremity of young Bellouguet cane, and having the density 1030 at a temperature of 77° Far., has given a direct notation of +8·3, and at 80° far. an indirect notation—6·1; this indicates after acidulation a total quantity of sugar equal to ·017 of the weight of juice whilst this liquid really contained ·054.

The quantity of uncrystallizable sugar in the top of the cane, in proportion to that in the body of it increases according to its distance from the lower part; and the part which contains the largest quantity is that which is completely shaded from the sun by the green leaves. This part of the head of the cane, of which the bark is very tender and uncoloured, remains, as long as it escapes the action of the sun, the chief seat of the liquid sugar which the plant contains; but immediately the leaves dry and fall the colour begins to change, and, at the same time, the uncrystallizable sugar begins to disappear, little by little, from its tissues, and gives place to sugar proper or crystallizable sugar. This remarkable transformation may be very easily observed in canes of similar standing; by analysing, at intervals of a few days, the part more or less covered with leaves, and, afterwards, the corresponding parts of other canes as far as they have became free from leaves, and coloured under the influence of the sun.

3.—The age of the cane appears to be only an indirect cause of the phenomenon noted. In placing the young canes under the conditions of aeration, of the ordinary light and vegetation of the plant when it attains the term of its development, I have ascertained nothing special with respect to the relative quantities of liquid and uncrystallizable sugar contained in the body or the head of the cane. In a general way it may be stated that the cane contains more uncrystallizable sugar the younger it is; but it is to the active vegetation of which it is the seat, and to the want of action of the rays of the sun on its stalk, closely enveloped as it is in a sheath of leaves, that the large proportion of inverted sugar it contains is to be attributed.

4.—Active or retarded vegetation exercises in reality, in this respect, as great or appreciable an influence as the light of which we have spoken. Canes arrived at maturity, and without a trace of levulose in the space between their knots, became rapidly charged with a large quantity of this substance when brought again into full vegetation; and as long as their leaves, green and flourishing, tend to renewed active development, and the buds open and the plant preserves the appearance of growth, one may remark that its juice abounds in uncrystallizable sugar, principally contained in the tissues newly formed, and consequently but little exposed to the light. In damp localities where the canes never ripen, and are constantly full of sap, uncrystallizable sugar always exists in all parts of the cane, and sometimes in very considerable quantities. In the month of December of last year, after a continued rain which produced great perturbation in vegetation, the juice extracted from the body of a Bellouguet cane, taken from the most rainy part of the island, contained 8·3 per cent. of sugar, of which 1·7 was inverted, and only 6·6 crystallizable. During all the time which during the last crop I devoted to the subject in different parts of the island, the researches I made confirmed the opinion at which I had already arrived, from the first experiments on my own estate.

I have found in specimens of cane and of juice which have been obtained from parts of the island, the natural humidity of which has been this year greatly increased by the abundant rain, a much greater quantity of uncrystallizable sugar than canes from the same localities in former years have given. Thus, also, I have found an average of 14 grammes of liquid sugar in 1,000 grammes of juice, on an estate where the rains had been abundant, and only 4 grammes per thousand in juice from another estate more favourably circumstanced.

When the proportions of the two species of sugar are determined in different phases of vegetation, it is always found that the largest quantity of levulose exists in canes which have been rapidly developed; and in this respect the canes which are called "foolish," and which in two months sometimes attain a height of five feet, with a diameter of three or four inches at their base, may be placed in the first rank.

The following is the analysis of one of these canes, the one which contained the largest proportion of uncrystallizable sugar I have noticed:—

Sugar	Crystallizable	3·6
	Uncrystallizable	2·4
Water, &c., &c.		94·0
		100·0

It is important to remark that these "foolish" canes shoot rapidly in the midst of large plantations which overshadow them, and that generally their bark is tender and uncoloured. We know already that this is one of the most favourable circumstances for the predominance of inverted sugar. When, on the contrary, the cane shoots regularly and slowly in the field where it receives the direct action of the light, it never contains in its middle part, even when the stalk is just beginning to shed its dry leaves, more of inverted sugar than one-tenth of the whole saccharine matter contained in the juice. This proportion of levulose rapidly decreases as the stalk is disengaged (from the leaves), unless the vegetation takes all at once an abnormal activity.

5.—Having admitted the formation of uncrystallizable sugar in the cane, it is important to ascertain the precise nature of this substance, and to determine whether its formation precedes or follows that of crystallizable sugar which is equally found in it; in other terms, if in course of modification it gives birth to this, or, if on the contrary, it is produced by the transformation of cane sugar proper. The insufficiency of the chemical means at our disposal for separating promptly and completely the two species of sugar without altering their original characters, may not allow us, for some time to come, to formulate the composition of the inverted sugar proper to this saccharine plant. The optical experiments which I have undertaken in order to ascertain the rotatory power of this substance have, as yet, I must acknowledge, led me to no very certain results. It may, however, be concluded that liquid cane sugar is generally left-handed (levogyre), but that this character is modifiable, and that under certain circumstances it has the property of turning partially to the right and of not becoming inverted by the action of diffusive acid, as though it was then partly left-handed, and partly right-handed non-invertible. This interpretation is needful, to explain certain apparently contradictory indications obtained by optical analysis of juice containing a large proportion of liquid sugar.

When after having directly examined the liquid, we invert it and again submit it to the action of polarized light, generally as I have said above, the deviation to the left indicates a smaller quantity of inverted sugar than that given by chemical analysis; but it also indicates that this quantity is equal or slightly superior to the quantity given by direct notation before the acidulation of the juice.

The rotatory power of levulose proper to the cane, without doubt, stronger than that of sugar artificially inverted, is sufficient to explain what happens in the first case, but it is needful to admit the presence, in the juice, of a dextrant other than crystallizable sugar, not capable of modification by acids to meet the second case.

May not this substance be that through which levulose passes in the formation of crystallizable sugar? Without substituting hypothesis for fact, and theory for observation, it is allowable to put this question, when it is remembered that I have clearly established above, the predominance of liquid sugar in the cane, of which the juice has not yet been completely developed, and its gradual diminution, in proportion as the crystallizable sugar increases; in fine, its persistance so long as vegetation continues, its disappearance when vegetation is suspended, and its reappearance when the plant begins again to vegetate.

Unless we admit, which is absurd, that the uncrystallizable sugar which exists in the cane under such circumstances, *i.e.*, when the plant is in full vigour, is only a product of an operation similar to that produced by fermentation or the action of acids on crystallizable sugar, it is difficult to arrive at any other conclusion than I have done, from the transformations of which I have described the different phases. In this hypothesis, cane sugar proper, that, which as a whole is found in the mature plant, would not be directly produced from the liquid which permeates its different vegetable tissues, but it would be gradually developed at the cost of another body already possessing a very great similarity to it, which achieves this modification under the double influence of vegetation and the solar rays.

6.—To sum up, the sugar which originally exists in the tissues of the cane, differs in more than one respect from that which is extracted at the period when the plant being completely developed has arrived at maturity, and it must be admitted that crystallizable prismatic sugar is the definite result of a process analagous to that which takes place in the formation of glucose, but, that whilst this is the last term of an operation which can be performed by artificial means, the other, on the contrary, can only have birth within the vegetable organization, and under the influence of vital forces.

The processes which I have followed in determining the nature and the quantity of the sugar contained in the juice of the cane, are those which, capable of the most exactitude, are those employed in similar circumstances. Having merely followed the common track, I have spared the reader the fatigue of descriptions of processes, with which he may bo perhaps more familiar than myself. There is, at the same time, a re-agent which I have used particularly, and which, on that account I take the liberty of making known at the end of this chapter. This re-agent is formed by a solution of oxyde of copper in a concentrated solution of caustic soda. In its preparation certain precautions aro needful, without which, the dissolution of the metallic oxide does not take place. Put a cubic demi-centimetre of a weak solution of sulphate of copper into a glass, throw in rapidly about 25 cubic centimetres of soda, giving the liquid a rotatory movement in the glass, and keep stirring rapidly with a glass rod. A beautiful deep blue liquid is thus obtained, which must be decanted, to separate a small quantity of oxide of copper, which is precipitated; the liquid must then be kept from the light. It is important to avoid contact with vapour of ammonia, for any trace of this alkali completely disturbs the effect produced by this cupio-sodiac liquid. For experiment, throw into the juice supposed to contain inverted sugar about a third of its volume of this liquid, and leave the mixture to itself; in two or three minutes it passes from a beautiful deep blue to a violet red, if the juice contains the smallest trace of glucose. No other substance contained in the juice of the cane possesses the property of producing a change of colour so clearly defined, so that, from its sensitiveness, and the facility with which it is used,* it is a very convenient re-agent for ascertaining the presence of inverted sugar in the liquid extract of any plant whatever; but, from its instability, due to the slowness of the separation of the metallic oxide, it cannot, like the liquid of Frommherz, be used as a test.

III.—ORGANIC MATTERS OTHER THAN SUGAR.

A great number of organic substances, more or less defined, have been indicated as contained in cane juice, but as they are far from all being of equal importance during the process of extracting the sugar, I will direct attention for the present to those only which exercise a perceptible influence on the quality of the juice, reserving the rest for future and special consideration. The basic acetate of lead added to the cane juice produces an abundant precipitate, in which are found involved the greater part of the vegetable matters other than sugar; this precipitate as may be ascertained, also contains in the form of salts of lead some of the acids which are found in the juice in combination with their alkaline bases. If the acetate of lead is employed to determine the quantity of these organic substances, it is necessary to take account of the action of this salt on the carbonates, chlorates, and sulphates of the juice, otherwise the results first given will show too high a figure. I have used the basic acetate, but I have had to deduct from the precipitate obtained the weight of the quantity of insoluble salts involved at the same time in the vegetable matters.

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* This reagent, as I showed some years ago, has tho property of turning violet under the influence of tho albumen of the egg, of blood, and of most liquids contained in animal organisations, but does not change by contact with vegetable albumen, nor by that contained in human urine in certain pathological cases. The nitrogenous substances contained in the cane, have not the power of turning this blue liquid red, inverted sugar is the only substance capable of producing this change.

I have given in the general table, before inserted, the weight of these matters contained in 1000 grammes of juice, from canes taken in different conditions of age, climate, &c., and I have estimated the average at 3·5 thousandths of the weight of juice; I have besides noted that they are augmented by increased pressure, and that they may thus give increased labour to the maker.

Whatever cane is under examination, it is invariably in the juice obtained from the head of the cane that the largest quantity of vegetable matter is found. Canes which have not completed their development do not generally contain a greater quantity than ripe canes, if the weight of these matters is compared with that of the juice, and not as some anthors have said—with the weight of the whole matters in solution.

We group these diverse matters under three heads—one comprising those already described as granular; another, the albumen of the juice or other substances coagulable by heat; the third, one or more nitrogenous substances, coagulable alone by alcohol or metallic solutions; we shall find them exist in the following proportions:—

Granular Matters	·287
Albumen	·076
Other Vegetable substances	·637
	1·000

And as they enter into the totality of the juice in the proportion of thirty-five ten-thousandths, it follows that 100 parts of the liquid contain of

Granular Matter	·1
Albumen	·027
Other vegetable substances	·223
	·35

The albumen which is found in cane juice coagulates at 176° Fahr., and is generally precipitated by powerful acids without sensibly re-dissolving in excess of the reagent. After the separation by heat of this albumen, there remains in the syrup a complex organic matter, precipitable by alcohol and by neutral acetate of lead, and very soluble in alkalies and acids, even in tannic acid. Isolated and purified by many precipitations by means of alcohol, this substance is free from taste and smell, white, amorphous, without action on polarized light, disengaging ammonia when heated with lime or potash, deliquescent though only partially redissoluble after isolation. Left to stand in water, it forms a viscid muddy solution; mixed with sugar and water, it renders it also equally viscid, and it appears to me to be the real cause of the viscid consistence which juice or syrup takes just before fermentation. This matter, escaping the action of all the agents employed to purify the juice, accumulates in the liquid and is found in considerable quantity in the syrups. It may be considered as one of the chief causes which oppose the extraction of sugar from the second boiling, because it is a powerful obstacle to regular saccharine crystallization. This substance, complex in its nature, plays an important part in colonial sugar manufacture, and deserves on this account to become the object of more complete study. I shall presently determine the quantities contained in different kinds of syrups.

IV.—MINERAL SUBSTANCES.

After numerous analyses, I have estimated the quantity of mineral salts contained in juice from well cultivated canes to be 2·9 for 1000 parts of the liquid (·29 per cent.). The saline matters, as the organic substances, are found in greater proportion in the head of the cane than in any other part. The results of analysis have not always confirmed the opinion so often expressed, that salts are found in much greater proportion in the juice of young canes than in that of mature ones. On the contrary, the nature of the soil appears to me to have a marked influence in this respect, and it is to this cause that the constant variations in the figures representing saline substances in the juice must be attributed.

The fixed mineral matter found in juice is chiefly formed of potash, soda, lime, oxide of iron, in the states of carbonate, chlorate, sulphate, biphosphate, and silicate, with which are often mixed salts of alum and magnesia.

The following analysis of ashes from juices extracted from a number of different species of canes under various conditions of cultivation, may be considered as presenting the average proportions in which the most important of the different substances are contained in juice:—

Potash and Soda	18·83
Lime	8·34
Oxide of Iron	1·99
Silica	11·48
Alum, Magnesia, and Acids in combination with their bases	59·36
	100·00

The planters of Mauritius having been twice obliged by circumstances to modify their articles of culture—being once forced to discard the Otaheitan cane, and another year to cultivate less exclusively the Bellouguet variety: it may be interesting to inquire if the ash from these species present any material modification in the proportion of their constituent elements. The experiments I have made with this end in view have been without result. I have always found the same saline matters which are found in juice in its normal state; and with regard to fixed alkalies neither increase nor decrease capable of being referred to other than accidental causes and errors often made in such analyses.

As a conclusion to this branch of my subject, I give below the average quantities of fixed salts contained in the four species of canes cultivated in this colony. This quantity has been determined by the incineration of small pieces of cane after they had been dried several days in a stove, at 212° Fahr.

	Bellouguet.	Guinghan.	Bamboo.	Penang.
Water, Sugar, and organic matters..	98·8	98·9	99·32	99·1
Salts............	1·2	1·1	·68	·9
	100·0	100·0	100·0	100·0

(To be concluded in our next.)

"THE SALANGORE CANE."

EXTRACTED FROM THE PROCEEDINGS OF THE CHAMBRE D'AGRICULTURE DE LA BASSE-TERRE, GUADALOUPE.

[Translation.]

The Report of the Commission on the Salangore Cane being called for, M. LE DENTU proceeded as follows:—

In March of the present year, the attention of sugar planters, and of all interested in the prosperity of the country, was called to a cane piece on the estate of Grand-Parc of about two acres in extent, on which had been growing what was called the Salangore Cane, which cane piece had produced, it was said, nearly twenty casks of sugar, the only manure used being that from the farm itself.

Having acquainted myself with the facts of the case, the exact area of the cane piece, and the precise amount of the produce, I saw that it was of the utmost importance, to be sure that this was not merely exceptional and accidental, like the extraordinary yields which sometimes occur, and to authenticate the results which might be obtained by the further cultivation of the same cane, as near as possible in the same conditions on the same estate.

With this end in view I introduced the subject here, and invited the Chamber to make it the object of serious examination; and as the proprietor of the estate at Grand-Parc, M. Eggimann, was a member of this Chamber, I suggested that he should inform you, as completely as possible, of all the circumstances connected with it; our colleague then stated:—

"On the estate of Grand-Parc the culture of the cane was on the point of being abandoned on account of the unsatisfactory results obtained by the Otaheite cane, when my attention was called to another species which was growing on the estate."

"M. Dubreuil, manager of the estate of Grand-Parc, struck by the singularity of this cane, plants of which were scattered here and there throughout the estate, and which contrasted with the other canes that surrounded it by its very rigid stalk without shoots; collected a number of plants, giving no heed to the prejudices against it entertained by all about him. He soon had a small plantation of it large enough to produce two hogsheads of sugar. He was told he would not be able to make sugar from it, or, at best, he would only obtain, with a great deal of trouble, an inferior article. Contrary to these predictions, the sugar from this cane is easily made, the produce is good, and the yield very satisfactory.!'

These first experiments led to a more extended cultivation of the cane, and this year, in the month of March, a cane piece of about 2¾ acres was cut, which yielded, from the account sales, 190 cwts. of sugar, superior in quality to 'bonne quatrieme,' without other manure than a basket of farmyard dung to each root—say over 4 tons to the acre. And it must be noted that in consequence of important repairs being in progress at the cane mill of Grand-Parc, the canes which were at maturity in January were not cut till March, so that it has been calculated that in the piece, there were spoilt canes which would have produced two casks of sugar." "There is," continued M. Eggimann, "on the estate at Grand-Parc, another cane piece planted entirely with Salangore cane, ready to cut, and of which the Chamber is at liberty to superintend the cutting and ascertain the yield."

"This cane," added M. Eggimann, in conclusion, "from my observation, can be no other than the Salangore cane, of which we have a detailed account in the '*Practical Sugar Planter*,' by Mr. Leonard Wray."

The Proprietor of Grand-Parc having thus confirmed with precise details the facts to which I directed your attention, the Chamber named a committee charged to watch the cutting and manufacture of the remaining canes of the species in question, and to note the results. The committee was composed of MM. Cesaire Michaux, Amé-Noel et Fereyre, and the President of the Chamber.

The cutting should have commenced towards the middle of April, but an accident to the mill at Grand-Parc delayed it several days, and unfortunately, heavy rains fell in the interval, so that in the opinion of competent persons the canes had begun to spoil when the cutting commenced.

The committee was to have met on the 28th of April, but unfortunately one of its members was unable to be present—M. Cesaire Michaux was then suffering from an attack which eventually carried him to a premature grave.

The committee, on the way to Grand-Parc, called at the house of M. Dubreuil at Grandval, and examined the passage in Mr. Leonard Wray's work of which M. Eggimann had spoken. This passage it may not be out of place to produce here.

"In the Straits settlements of Penang and Province Wellesley, Singapore and Malacca, the principal canes are eight in number. Of these, first and foremost is the Salangore cane, by the Malays of Province Wellesley termed 'tibboo bittong beraboo' (the powdery bark cane); but by the Malays of Singapore and Malacca it is named 'tibboo cappor' (the chalk cane), from its having sometimes a considerable quantity of white resinous substance on the stalk. *This is the* FINEST *description of cane in the Straits settlements, and* PERHAPS IN THE WHOLE WORLD.

"I have cut as many as five of the larger canes from one stool, each cane from ten to fifteen feet long, without leaves, and seven and a half inches in circumference (round the lower joints); each cane weighed from 17 to 25 lbs. That of 25 lbs. I kept for some weeks in my house, and numbers of people saw it; it was thirteen and a half feet long, and two and a half inches in diameter; yet it was not by any means so large a cane as I have seen.

"The place where I found it growing was a newly-cleared piece of jungle land, whereon a Malay had 'squatted,' built a house, planted rice, and some three acres of sugar cane around it. The cane plants had been stuck into the ground without any regard to regularity, and had received no kind of attention; yet I counted twenty-five canes of immense size growing from many of the stools. This is by no means a solitary instance.

The Salangore cane is remarkable for the quantity of "cane itch" which is found on that portion of the leaf attached to the cane stalk. The leaves are very broad, and deeply serrated at the edges, with a considerable droop; they are some shades darker than the Otaheite, and have so good a hold on the stalk as very seldom to fall off when dry, as some canes do, but require to be taken off by the hand. They rattoon better than any canes in the Straits, and I have known them to yield 40 piculs of granulated, but undrained sugar per orlong as third rattoons (about 1¾ tons to the acre.) As plant canes, I have known them yield 6,500 lbs. per acre.

For my own part, I have always reckoned, as an average, 3,600 lbs. of dry sugar to the acre as the return this cane will give on anything like good land in the Straits, according to the present imperfect mode of expression and manufacture; but, considering the surpassing richness of land in the West India Islands, Demerara and Mauritius, I should not be in any way surprised to find that it would there give even three tons to the acre.

The Salangore cane grows firm and strong, stands upright much better than the Otaheite, gives juice most abundantly, which is sweet and easy of clarification, boils well, and produces a very fine fair sugar of a bold and sparkling grain. On the whole I like this cane better than any other, and would like to have it tried in the West Indies and Mauritius."

From Grandval the committee proceeded to Grand-Parc, accompanied by M. Eggimann, the proprietor, and Mr. Dubreuil, the manager. The mill on the estate is said to be of great power, though with vertical cylinder. The grinding had not commenced, but some of the canes from the piece in question were cut and laid in heaps ready. We observed that the cut canes presented a dull whitish appearance, not at all prepossessing in their favour. We were also struck by the closeness of the knots, which in most of the canes were not more than about two or three inches apart. Proceeding toward the cane piece, the committee observed plantations of the same cane of different ages, all of a remarkable appearance. They especially noted the young vigorous cane plants forming a mass of verdure, uninterrupted by the least blemish or discolour. They also remarked the great beauty of some rattoons* five months old, which they never saw excelled on any other plantation.

Especially by the number of canes to each stool, and by the regularity of the stools, succeeding each other without interruption, the plantation in general was worthy of note.

The committee found in the piece which they had come to examine, canes of great beauty, with stalks erect and firm, without any vestige of sprouts. It was easy to pass between the rows by pushing aside the matted masses of leaves. Here, as in the other pieces, the stools were regular and very luxuriant. Those in the centre were fully equal to those on the outside. The number of canes to each stool averaged 20 to 25; many had 30, and on several, accidentally observed, we counted 40 canes.

Comparing those before them with Mr. Wray's description of the Salangore cane, the same characteristics were remarked, with one exception: instead of the *deep* serrations spoken of by Mr. Wray, the committee only noticed that the leaves were more generally serrated than those of ordinary canes; but they are satisfied that the cane of Grand-Parc estate is really the Salangore cane.

M. Eggimann stated that the piece had been planted in September, 1866, with potatoes between the rows; but owing to the gathering of the coffee crop (Grand-Parc is a coffee, as well as a sugar plantation), it was not manured till January, 1867—the manure consisting of one basket of farmyard dung to each root. The canes then, were 19 months old, reckoning from the planting, and 15 months from the manuring; but they were ripe and ready to cut in March.

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* These rattoons produced 8 casks of sugar (about 4 tons) on an acre and four-fifths.

These particulars obtained, the committee had the piece measured in their presence. Its extent was about three acres.

They then had cut before them 16 stools of canes, occupying an area of 45 square yards, taken at random from the piece—the stools not more luxuriant, nor the canes finer than the average. These weighed 850 lbs.

They were passed through the mill separately, and gave 224 litres of juice (49 gallons).

The committee observed that the canes, or at least part of those examined, had begun to turn. The megass from these canes was in small pieces, but was not the less serviceable as fuel, and was sufficient, with the addition of a quantity of trash, to supply the furnace during all the grinding.

The juice from the mill was very abundant, and gave 10¾° during the first few days, and 11° afterwards.

The sugar is very easily made, without the use of any other reagent than lime. It is of very good quality, with a grain hard and brilliant. In fine, the yield of the piece was 21 casks and a half averaging about 10½ cwt. each, 11·2 tons for the entire piece, or nearly 3¾ tons per acre.[*]

This, gentlemen, is what we have seen and what we have verified—full proof of the statement which determined you to appoint the committee of which I have had the honour of presenting the report. I say full proof, for though M. Eggimann stated that the first piece yielded 17 milliers of sugar per hectare, and would have surpassed this return by 2 casks per hectare, but for the quantity of canes spoiled (traces of which the committee observed), and the piece the cutting of which we superintended produced ony 18 milliers per hectare, we must accept M. Eggimann's statement that the canes on the first piece were finer than on the second, and I have observed that they had begun to turn. But of what importance are one or two milliers to the hectare? Take the facts, irrespective of any suppositions likely to augment their importance. Is it not very significant that we possess in the colony a cane capable of producing—without other than farm manure in moderate quantity—between 3 and 4 tons of sugar to the acre?—a cane which surpasses in our country what Mr. Wray hoped from its culture in the West Indies.

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[*] The *exact* return, afterwards ascertained, was 21½ casks, each weighing 10 cwt. 24 lbs. nett. 10·6 tons for the piece, or 3½ tons per acre. The sugar sold for twenty shillings per cwt.

Are these canes a recent importation into the colony? By no means. Strange to say, the Salangore cane has long existed in Guadaloupe. It was cultivated by Mr. Navailles on the estate of L'Ilet, and, although the canes were fine, the yield was small. At Mount St. Louis and on the Belost estate, at present belonging to our colleague, M. Cabre, it is found in considerable quantity mixed with the cane of Otaheite; as well as on some other estates. But from all those to whom we have mentioned the wonderful results at Grand-Parc we have invariably received this answer—"We unsparingly destroy it. Not only we cannot make sugar from it, but it impedes the manufacture from other canes when mixed with them, because of the great quantity of scum which it produces, and it does not give sufficient megass for the mill fire.

The facts which we have stated are quite sufficient reply to these objections. It is certain that sugar is easily made from the Salangore cane, and beautiful sugar, too; and it is certain that the megass is sufficient for its manufacture, without the use of much more trash than is required by other canes.

At the same time, though, it may not be out of place to examine the objections made to the Salangore cane—the causes which have prevented its good qualities being known up to the present time—and to answer as far as possible the arguments adduced against its cultivation.

To begin with the least important—that the Salangore cane does not furnish in itself sufficient fuel. Against this is the fact that the short distance between the knots (remarked above) causes the production of a larger quantity of leaves, so that, if it is needful to burn trash—so precious for farmyard use and to increase the manure—after part of the cane trash (*i.e.*, the dry leaves) has been used to aid in firing, there still remains on the piece a quantity equal to the whole furnished by other species of cane. But whence comes it that the culture of Salangore cane should be an object of general prevention because (as is said) it will not alone make saleable sugar, and that it hinders the production of sugar from other canes with which it is mixed?

We can only suppose that these serious defects are the results of the cutting of the canes before they are fully ripe. A few have been cultivated on the neighbouring plantation of Basse-Terre, but a little distance from the coast. There the Salangore canes were cut at the same time as the Otaheite, which were only a year old; and it is certain that the former variety are far from being ripe at this age.

On the estate of Grand-Parc, cultivated with care and alone, this cane has been allowed to stand long enough to arrive at complete maturity. But the time exceeds that allowed for the ripening of canes generally, and the age named in books on the subject.

M. Leonard Wray does not mention the age when the Salangore cane is mature, from whence we may conclude that in this respect it does not greatly differ from other canes of which he wrote.

For the Salangore cane, as well as for other varieties, the age of maturity necessarily varies according to the situation of the estates and the atmospheric conditions. But the committee do not think that this cane differs much from others in this colony as to the time generally required to ripen, and they ground this opinion on the experience of the Grand-Parc estate.

The cane piece to which our attention was first directed was cut in March, 1868. It is true it was planted in June, 1866, but it was not manured till November of the same year; and if twenty months had elapsed from the planting, more than five of these it was without manure, and the canes were quite ready for the mill by January. The delay in the repair of the machinery only prevented the cutting, and this explains the quantity of spoilt canes, of which the committee saw traces on the piece.

Amongst the cane pieces, the beauty of which fixed the attention of the committee, was one of first ratoons. The canes had been cut in March, 1867, manured a month later; the rattoons were ready to cut when the committee was at Grand-Parc, and were manufactured immediately after the canes of the piece which was the particular object of observation. The latter, as has been said, was planted in September, 1866. Neglected at first, it was not manured till January, 1867, and was ready for the mill in March, 1868.

For these reasons, the committee are of opinion that at Grand-Parc the crop of plant canes might be cut at 16 or 18 months, and of rattoons at 12 or 13 months.

It must not be lost sight of that this estate being in an elevated situation is not in the best condition possible for cane cultivation, and that vegetation there will not be so rapid as on lower lands or nearer the coast.

To recapitulate; from the report of the committee, and the accounts furnished by the proprietor and manager of Grand-Parc both of them members of this Chamber, the qualities by which the Salangore cane is distinguished and recommended, are,

1.—Planted at considerable distances (two metres each way), an essential condition, and manured at the proper time, the Salangore cane shoots with so much vigour, and with such large stools, that in five or six months it forms a mass of verdure, which covers the soil in such a manner that there is no room for weeds to grow. This the committee observed in one of the cane pieces before mentioned. The weeding is thus reduced to a great extent.

2.—To obtain these results, a basket of farmyard manure is sufficient for each root.

3.—The canes grow straight and strong, as Mr. Leonard Wray says, and do not mat together. If by a violent wind the canes be blown over, they are still entire, and in this position will continue to vegetate, except those most deprived of soil, which perish for want of nutriment.

4. When, by the vertical growth of the canes, the soil which was hidden by the young shoots becomes uncovered, the leaves, which are very abundant and drooping, cover it again. The first falling is sufficient to hide the soil and prevent the growth of weeds.

5.—From this moment up to the time of cutting, the cane needs no more than the usual trashing.

6.—There is no notable difference, (and this may be prevented) between the age when the Salangore cane ripens and the time when the other canes are generally cut.

7.—The Salangore cane passes through the period of sprouting without doing so.

8.—The stools bear from 25 to 30 canes.

9.—In consequence of the enormous quantity of canes on each stool, the weight of cane per acre is much superior to that of ordinary varieties. Sixteen stools of cane, not the finest in the piece, covering a space of 45 yards, weighed 851 lbs., from which, by the rule of proportion, the return per acre is about 40 tons. For the weight per acre of ordinary canes we have it on the best authority—"The canes of Guadaloupe do not weigh, on the average, 16 tons to the acre. On the estate of Grand-Terre only 12 have been obtained, and at the Beaufort factory the average of the last five years has been 11 to the acre.

10.—The megass from the Salangore cane provides sufficient fuel, with the addition of a proportion of trash—a quantity which leaves on the soil for the use of the farm more trash than other species of canes.

11.—The juice pressed from the Salangore cane is abundant.

12.—The sugar is easily made, without the use of any other ingredient than serves for the manufacture of sugar from other canes.

13.—The sugar is of good quality, and the grain hard and brilliant.

14.—The return per acre is incomparably superior to that from other canes.

Then, gentlemen, if the Salangore cane keeps in the rest of the colony, the promises it has made at Grand-Parc—if it justifies the hopes which it has raised—even if its return in other parts should be only a fourth, a third, or a half that recorded, its propagation in the island will be an immense benefit, and will consolidate the service which the introduction of central factories has already conferred upon Guadaloupe; and it will not be denied that the gentleman I am about to name has acquired the right to the recognition of the country from the judicious and observant spirit, the persevering study, by which he restored to cultivation a cane hitherto decried, but destined, from all appearance, to double at least the quantity of raw material furnished, either to the old works or to the central factories, which are destined, on their part, to double and to improve the produce of sugar.

The committee propose that the congratulations of the Chamber be presented to M. Dubreuil, whom it is happy to count amongst the number of its members."

Interesting as the foregoing report undoubtedly is, there are several circumstances which must be taken into account, before it will be safe to conclude that this cane (whether it prove to be the Salangore variety or not,) is more useful and valuable than the Otaheite cane.

It is well known that on good well tilled land suitably manured, the Otaheite cane will, in favourable seasons sometimes yield a crop exceeding the average two, three and even fourfold. We are not informed what crop was taken from the experimental cane patch at Grand-Parc during the previous season, and the absence of this information is unfortunate. It is to be noted that each cane stool was supplied with a basket of cattle pen manure, equal in amount to four tons per acre. The canes were suffered to attain their full maturity, and as it is now generally admitted that this variety requires a longer time to ripen than the ordinary sorts, the delay in reaping probably aided the experiment very materially. The mill had undergone extensive repairs and with such effect that the megass emerged in small pieces, a conclusive evidence of severe pressure, which might also account for the further "accident to the mill." Thus it would not be safe to conclude that this experiment on canes, grown upon well manured land and subjected to extra pressure, owes its successful results entirely to its being a new variety of cane.

This experimental patch in Guadaloupe yielded 40 tons of cane to the acre. This is certainly a large crop, but it has been often exceeded by the crops of ordinary canes, (probably Bourbon and Ribbon,) grown in Queensland, as related in the first number of this magazine. It is also less in amount than is frequently obtained in Natal and in Central America. The new variety of cane requires eighteen months to bring it to maturity instead of fifteen, which is a very serious objection to its general adoption, and fully accounts for the planters' ready destruction of every plant they find amongst other cane patches. The large proportion of fructose found in unripe canes fully justifies this mode of treatment.

Mr. William Russell of Demerara, has paid a visit to the French Antilles since the cultivation of this new variety of cane has been undertaken. In an interesting private communication he writes: "the Salangore cane of which we have heard a deal about lately, is not in favour in Grandeterre; the planters say it takes too long to ripen (18 months); it is more thought of in Cabesterre and Basseterre, and I saw some fine plots growing in both districts, and in some instances one can distinguish stools of the Salangore growing among the common canes from their extra luxuriance, they are easily distinguished by the blade, which has no saw edge to it, the same as in the common varieties." Mr. Russell distinctly tells us that the leaf has no saw edge, whilst the French Committee "noticed that the leaves were more generally serrated than those of ordinary canes." A few plants have been conveyed to one of the English West India Islands, and we are promised a report upon their growth, yield, &c., in due time; they have only been planted a few months, and we are told that at present they are not readily distinguishable from ordinary canes. The subject is an interesting one, and even should it be shown on further cultivation that the first experiments in Guadaloupe were made under exceptionally favourable circumstances, this cane may yet prove to be a valuable addition to the varieties grown in our West Indian Colonies.—*Ed. S. C.*

SUGAR CULTIVATION IN UPPER EGYPT.

From the "Revue des deux Mondes" dernière partie d'Ahmed le Fellah.

By M. E. About.

We approached the village of Erment, where H. H. the Viceroy possesses a very extensive sugar plantation and a large refinery. My friend, the "fellah," told me "under the rose," that this branch of agriculture and of industry required considerable reformation; and he added, with some emotion—God grant that our Seigneur (in Arabic "effendina") may once reap of his real estates the revenue which he has a right to claim! He will then be the richest proprietor in the civilized world, he will need no more to levy taxes, and he would then be able to render assistance to the people of Egypt with his own means.

This little prophecy needed some commentary. When arrived at the factory, I got hold of somebody who understood the right and the wrong of the question, and I met with an honest Frenchman, who was well instructed and full of ideas, which, I fear, his modesty does not allow to be brought into practice in his smaller occupations. His name was Guérin, and he was somewhat acquainted with our Ahmed. In less than an hour he gave me every information I wanted.

Upper Egypt, if well cultivated, would easily be transformed into a sugar mine. One "hectare" of good land produces 90,000 kilos. of cane, (36 tons per acre,) yielding 3½ tons of sugar, and about 1 ton of molasses. There are few or no colonies where planters obtain the same profitable results; in the Antilles, la Réunion, and Mauritius the soil is exhausted, and it is only by using guano that half a crop is reaped there.

All Egyptians are allowed to cultivate sugar cane, to grind it, to boil the juice, and even to refine sugar if they wish to do so; but the necessary machinery for this branch of industry is obtained at so high a price that, only a man with a fortune of the Viceroy is able to erect a sugar factory. The Prince Halim and Mustapha-Pasha, who formerly worked the refineries, are nearly ruined; Ali-Pasha and Ahmed prefer agriculture to industry, and for this reason, the manufacture of sugar has become almost the monopoly of the Governor. The manufactory of Erment is not only supplied by the surrounding crown lands of the Viceroy, but also by the small landowners of the neighbourhood, who cultivate the cane in order to sell it. The machinery nsed for manufacturing sugar is of the best quality, it is only necessary to say that it came direct from the firm of Cail. It is a great drawback that coal delivered in the stores of the factory costs nearly a hundred francs per ton, or ten times more than in Manchester.

The culture and the management in the first place need re-organization.

Of every ten canes the Egyptians cut, they carry nine to the sugar mill, whilst they keep the tenth for planting in again. The whole of this cane is buried, and from every knot a number of young plants shoot up again. This method of planting is doubly absurd; it is foolish to bury every year the tenth part of a crop which could be used with more profit, and it is at least useless to grind the tops of the canes which give an inferior juice containing little sugar. It would be far better to cut off the upper part, (bout blanc) which is sufficient for planting, and to press between the rollers all the richer parts of the cane. To the saving of ten per cent., an important reduction of fuel and labour would be added, they would not only obtain a larger quantity of juice, but a juice containing more sugar, and which could be evaporated with less expense. The natives plant too closely, which prevents the air from circulating between the branches, and the plant inhales badly, the bottom leaves die, and the cane grows taller bnt does not become thicker. The farmers for their interest, and the agents of the Viceroy, in their zeal, irrigate the sugar-fields when it would be better to suspend it, a month before cutting the cane. The canes they send to the manufactory are over-fed with water, and, therefore, poor in saccharine substance; this excess of humidity which they have to get rid of, requires a heavier expense of fuel. It is almost impossible to keep the fellahs from increasing the weight of their harvest, they will always work like tho farmers in Flanders, who sell their beetroots by weight, they of course like them better heavy than rich. Still, it would not be difficult to induce the "employés" of the *daïra*, who cultivate the lands of the Prince, to follow a more logical method; it would suffice to trust the agricultural management to the care of one director. At present, everybody "tire á soi;" le *mouffétich* of the plantations works hard and is astonished when a large quantity of sugar cane has not produced a large quantity of sugar; the managers of the factory reply: You don't deliver us sugar canes, but long sticks filled with water! And the Viceroy does not know whether the revenue of his admirable sugar factories surpasses the cost of working them. I think he could every year make a profit of about ten millions (£400,000), without using pigeon manure, and without exhausting the soil. The suppression of the use of pigeon manure would cause a slaughter of pigeons, and in consequence, an enormous increase of the production of corn.

I enquired the amount of wages paid in Erment.—The country labourers required for different services, get one piastre and-a-half, about forty centimes, (4d.) per day. They receive this payment in the shape of bread, and they declare themselves satisfied when those who have charge of the partition of rations don't take the largest portion.

On the morning of the 26th, we were invited by the Princes to witness a tourney-performance. A lance-tilting in the yard of a refinery! It was, certainly, the first time a festival of this kind had taken place in a building of that description. The majestic noise of the engines was strangely mixed with the crying expressions of a wild music, the pistons went backward and forward in their cylinders, the apparatus of Mr. Cail absorbed the sugar in the shape of dark liquor, and gave it back in the shape of white powder, whilst a dozen 'cavaliers' holding their lances, with their shields hanging at the saddle bows, practised the heroic game of the middle ages between two heaps of coal. A buffoon enlivened the festival by pasquinades; sitting on horseback on a sugar cane three yards long, he jumped amongst the crowd, crept between the legs of the parade horses, shouted in a heroic-comic manner, and came back to us petting his Rosinante, with a gesture which Diogenes would have admired.

When the feast was over, we took a look through the works, and the young Mussein-Pasha surprised us by the extent and variety of his knowledge. He has the most practical mind of the whole family, and seems to take a particular pleasure in the study of statistics and social economy.

IMPROVEMENT OF THE SUGAR CANE BY CROSSING AND SELECTION.

(From the Barbadoes Reporter.)

FOR ALL SUGAR-CANE PLANTERS.

TO THE EDITOR OF THE REPORTER.

Dear Sir,

There is before me the first number of a new magazine called "*The Sugar Cane*," published by Galt & Co., of Manchester, England, which "*aspires to be the medium of communication between those directly interested in the growth of the cane and the manufacture of Sugar in all parts of the world;*" and, as it promises well from the talent evinced in selecting matter for the prospectus and first issue, as, also, from the authorities on "Sugar" contributing to its pages, will supply a decided want for the planters. It is to be hoped that it will be encouraged by subscriptions and contributions from the Agricultural Societies and the planters of Barbadoes and the neighbouring islands. Chiefly with the view of giving this new journal a helping hand, I send you this introductory communication on a subject of vital importance to all Sugar-cane Planters through the world.

"Every sugar planter in all parts of the globe is now aware of the rapid degeneration of the sugar cane; one sort after another failing to grow with former vigour, or equal saccharine strength of juice. Changing of plants from soil to soil, and the very superior tillage of Barbadoes and fertility of its land, and of the neighbouring colonies, has not brought this fact *so* much home to us. But the present product of sugar from our fields does not compare with the hard, firm sugar of former days, which, it is said, would hold together if even the outside of the cask was removed. Well, now this degeneration being known and acknowledged through the world, there have been, as yet, from various places—the Mauritius, Natal, and from Queensland, &c., &c.,—inquiries for new and better sorts of sugar canes; and, in the French islands, close to us, the Salangore cane, recommended by Mr. Wray since 1851, has been introduced with success, and some plants of it, obtained from Guadaloupe, are now growing with us. Your readers will remember an extract published by you, as to selection of plants and some practical Darwinism being required to procure good canes and good sugar, and enough of it. A communication of mine was then withheld so as to be more satisfied, before giving publicity to my ideas on the subject. From reasons connected with personal observation and history, &c., of this island, and from the most attentive consideration and inquiry as yet in my power, I do not now hesitate to advise sugar planters as to a mode whereby the sugar cane may be (not Darwinised, but simply) botanised, so as to renew and *reproduce the best of sugar cane.* I reserve for a further memoir, details showing the accuracy of what I now propose. Suffice it, then, to say that as we get varieties of other plants, so will we get varieties of the sugar cane, even by and from the Sugar Cane Seed. Varieties *so* produced will speedily tell us their qualities, and, in the course of three or seven years hence, the sugar cane, properly botanised, may be as readily produced, even to suit every soil and climate, from its characterised seed, as it is now by its plants; just as wheat, potatoes, and even the grape is thus cultivated. But sugar-cane *seed?* No book on sugar tells us of it. All the sugar-books say that the plant will not *now* seed, or will only give imperfect seed, and such a seed is quite unknown. True; but it need not be so, for any sugar-cane planter who will allow a sugar-cane plant to fully ripen and arrow, (that is, to flower, as is the natural effort for reproduction in every plant before its decay) and on its arrowing or flowering will then envelope the flower or arrow in a muslin bag until it is fully ripe, and then search it, will find the seed in abundance; if unproductive, it can be made so by pollen impregnation; if the produce is not successful, it can be cross-bred, or even hybridised with some other of the grass species. In fact, it can be botanised, reproduced, and and improved to meet the want of every sugar-planting country *as long* as the sugar cane produces naturally, or by force of cultivation, &c., its own seed. The seed of the sugar cane is single, oblong, pointed, and ripens in the flower, which, being long, encloses and hides the seed from us, but not from the birds. The seed has been planted and grown previously by a Mr. Clarke, in this island, but this story was discredited. An accidental discovery of natural-grown seed plants is also on record here, having been published and shown at our Agricultural Society's Exhibition, and is beyond any doubt, as they produced vigorous transparent canes. But with this publicity, and the kind attention of many planters' friends, the question will soon be fully tried here, and, I trust, in all other sugar countries; though for its proper success it will require appropriate botanical appliances, time and trials, as above."

Your obedient Servant,

W. DRUMM.

Apart from Mr. Drumm's obliging recommendation of this Magazine, we have pleasure in giving insertion to his remarks on the improvement of the sugar cane; as, though not fully agreeing with the hypothesis or assertion with which he commences his letter, the subject is one to which he has done well to draw attention. That "every sugar planter in all parts of the globe is now aware of the rapid degeneration of the sugar cane," is, we hope, too sweeping a generalization; there is no doubt, that from faulty systems of cultivation, exhaustion of soil, neglect of suitable manuring and other causes, that some varieties of cane require change or renewal in many colonies, but that the sugar cane generally, is degenerating, there is scarcely evidence to show. It is possible that West Indian sugar is not so good in quality as formerly, but this, as Dr. Icery states, relative to the same fact in Mauritius, may be attributed to the greatly improved cane mills, which, along with the juice, express a larger proportion of vegetable and other substances which are unfavourable to perfect crystallization. "It will be difficult," he observes, "without denying the results of experiments patent to all the world, not to attribute to the more forcible pressure of the cane, what some have (wrongly I think) considered to result from its degeneracy." It is true that the "disease" which had seriously affected the canes, has more than once obliged the planters of the Mauritius to introduce new varieties into their island, which they have done successfully.

That it is the soil which is exhausted rather than the cane which is degenerating, is shown by the results which have been obtained in new countries—Queensland, for instance, where four tons per acre, of good sugar, have been obtained. The exhaustion of soil is of course the result of defective cultivation, insufficient or unsuitable manuring. Properly tilled land will improve in the course of time, the soil of England, for instance, has by no means deteriorated by the culture of centuries; it still grows wheat, barley and other cereals, at least in as great perfection as when the virgin soil was just reclaimed from forest and moorland; and there is no question but that the same care and attention, the same scientific skill, applied to tillage, drainage, irrigation, and chemical manuring, would have an equally good effect on the cane fields in Barbadoes and elsewhere, as on the wheat soils of Essex, or the grass lands of Herts.

But whilst wishing to point out that it is on improved methods of culture, more than on new varieties of cane, that the planter must mainly rely for renewed prosperity, we by no means wish to discourage Mr. Drumm and others in their praiseworthy endeavours to raise new varieties of cane. It is not at all improbable that if the cane can be raised from seed, or hybridized with other species of grass, some varieties may be produced which will ripen sooner, or resist drought better, or even prove richer in saccharine than many sorts at present under cultivation. We may, however, remind Mr. Drumm that more than twenty years ago Mr. Leonard Wray made several unsuccessful efforts to produce hybridized cane seed, after recounting which he says—"I must own I cannot well explain why planters should be so very anxious to obtain possession of cane seed; surely they cannot expect to obtain a finer variety of cane than the Otaheite or the Salangore!—a cane that under favourable circumstances produces from two to three tons of dry sugar per acre."

But whether it be possible to raise the cane from seed or not, it is quite feasible to introduce new varieties into our West India colonies from Queensland and the East by way of Panama. We do not think that any of our colonial governments will need much pressure to induce them to afford every facility for obtaining good varieties where they are to be found, and introducing them where needed. The Governor of Mauritius has lately been instrumental in procuring for that island a considerable number of cane plants, of many different varieties, from the Sandwich Islands, Queensland, and other parts.

It has been suggested that our colonial botanical gardens should set apart some of their space for experiments in cane culture; this has already been acted upon in the "Jardin des Plantes" of Mauritius, and no doubt the conductors of the many fine Botanical Gardens in our colonies, in Trinidad for instance, will be ready to do the same.

There is no question but that the introduction of new varieties of cane and the adaptation of species to soil and climate are important parts of that general improvement in cane agriculture, on which depends, in great measure, the future prosperity of the colonial sugar industry.—*Ed. S. C.*

STATISTICS OF THE YIELD, AND VALUE OF PRODUCE OBTAINED

On Seven Estates in Antigua, Crop 1869.

By W. T. Blackburn.

Estate.	Situation.	Estate.	Situation.
A..........	The Valley.	E..........	Middle of island
B..........	Popeshead.	F..........	Windward.
C..........	Middle of island	G..........	Windward.
D..........	Middle of island		

The tables show the number of gallons ground per week on each estate, the number of hhds. made per week for each, and the number of gallons required per hhd., from Jan. 23rd to July 17th, 1869. They are exact copies (made by permission) of the Boiling House Diary kept on each estate.

An exception to the weekly statement will be found in the case of A, as the totals only were obtained in that instance.

TABLE No. 1.

No. of Gallons of Juice Ground and Sugar Made Per Week. Crop, 1869.

Week ending 1869.		B		C		D		E		F		G	
		Galls.	Hds.	Galls.	Hds	Galls.	Hds	Galls.	Hds.	Galls.	Hds.	Galls.	Hds.
Jan.	23	..	..	..	..	3000	1¼	..	..	..	..	..	..
,,	30	..	..	..	..	5000	3	..	..	..	..	..	..
Feb.	6	..	..	..	..	2200	12⅜	4400	3¼	..	..	..	..
,,	13	17763	8¼	14500	10¼	11875	7	..	..	..	..	..	..
,,	20	24255	12	23000	15¾	16770	9½	..	..	..	..	..	..
,,	27	25848	12	12700	8¼	15250	11	..	..	..	..	21000	14
Mar.	6	12495	6	14300	9½	9350	5¾	9000	4¼	9250	5	..	,,
,,	13	24745	13	..	..	19510	12	18600	16	13500	6	15000	10
,,	20	23275	11¾	33000	23½	24000	13⅞	23600	11	19250	12	16900	13
,,	27	25725	14½	22700	14⅙	14500	8¾	3300	2½	15500	9	18000	12
Apr.	3	27440	13½	24600	17¼	25500	15½	23200	18	27000	16	19500	13
,,	10	25991	14¼	..	..	11750	7	20500	15½	27500	18	18000	12
,,	17	29573	17	29800	21½	14000	9	22800	17½	23000	16	23000	17
,,	24	25972	15	13400	8¼	22750	15	26150	19¾	26500	18	25000	20
May	1	26103	14	28400	20½	19250	12½	24500	20	26500	16	23000	14
,,	8	23775	13	16000	10	22000	14¼	24000	19½	29000	18	20000	13
,,	15	22295	12	29300	18⅛	17750	13¾	24800	20	9000	5	23000	19
,,	22	29641	16	28000	18½	18375	12	24600	14½	..	..	21000	14
,,	29	23154	13	25300	14	15000	10	18000	13¼	..	..	18000	7
June	5	21221	12	25400	16⅝	18250	11¼	13400	10½	29000	19	22000	19
,,	12	26215	13	18400	14⅙	..	..	17200	14	27500	15	15000	10
,,	19	13230	6	22900	14½	21000	13¼	14800	10	24500	15	9500	5
,,	26	14333	6½	11400	7	10000	6¼	11200	9	15000	10	12000	8
July	3	18499	10½	16600	9½	10000	5⅜	15200	10½	16000	14	..	..
,,	10	17885	8	..	..	12900	7⅞	18200	12½	5000	3	..	..
,,	17	20949	10	15400	11½	7750	4½	16400	12	..	..	..	..
		250472	271¼	425100	283¾	389525	242¼	373850	273½	343000	215	319900	220

TABLE No. 2.

NO. OF GALLONS OF JUICE TAKEN FOR EACH HHD. OF SUGAR. CROP, 1869.

Week ending 1869.	B	C	D	E	F	G
	Gallons	Gallons	Gallons	Gallons	Gallons	Gallons
Jany. 23	..	..	2400	..	..	..
„ 30	..	..	1667	..	..	..
Foby. 6	..	..	1777	1345½	..	..
„ 13	2153	1444	1696½	..	..	..
„ 20	2021¼	1460	1765¼	..	..	1500
„ 27	2154	1539	1386¼	..	..	..
March 6	2082½	1505	1643½	1333⅓	1850	..
„ 13	1903½	..	1625¾	1430	2250	1500
„ 20	1980	1571	1737	1329	1604	1300
„ 27	1800	1538	1657	1320	1720	1500
April 3	2032½	1538	1645	1325	1687	1500
„ 10	1824	..	1678½	1322	1639	1500
„ 17	1739¾	1386	1555½	1302	1437	1353
„ 24	1731½	1406	1516½	1324	1364	1250
May 1	1864½	1473	1540	1225	1656	1634
„ 8	1828¾	1440	1544	1231	1611	1539
„ 15	1857¾	1562	1300	1240	1800	1210
„ 22	1840	1622	1531¼	1696	..	1500
„ 29	1781	1741	1500	1384	..	2572
June 5	1768½	1587	1622¼	1278	1526	1150
„ 12	2016½	1672	..	1252	1833	1500
„ 19	2205	1690	1585	1480	1633	1900
„ 26	2205	1628	1600	1244	1500	1500
July 3	1761¾	1746	1860½	1447	1143	..
„ 10	2235½	..	1648	1456	1666	..
„ 17	2095	1711	1722	1366⅔	..	..

TABLE No. 3.

Crop, 1869.

Estates.	DATE: 1869.		Times Machinery has been at work.	Gronnd and Boiled, between the date given in previous column.	Density of Juice Beaumé.	Sugar Potted from Juice.	Average per Hhd.	Average Ground and Boiled per day.	Proportion of Molasses per Hhd.
	From	To	Days.	Gallons.	Degrees.	Hhds.	Gallons.	Gallons.	Puncheons.
A	Mar 11	Jul. 17	94	560,450	not recorded	500	1121	5962⅕	none
B	Feb. 8	Jul. 17	117	520,472	not recorded	271¼	1912	4448½	¾
C	Feb. 10	Jul. 17	96	425,100	11° to 12½°	283¾	1498	4407⅓	¾
D	Jan. 23	Jul. 17	95½	389,525	not recorded	242¼	1608	4075½	½
E	Feb. 6	Jul. 17	85½	373,850	recorded once 10°	273½	1367	4372½	½
F	Mar. 6	Jul. 10	70	343,000	9° to 11°	215	1599	4900	½
G	Feb. 22	Jun. 27	83	319,900	not recorded	220	1422	3859	½

The weight of a hogshead of Concrete is about 19 cwt. nett, when it reaches Liverpool; that of a hogshead of Antigua sugar is usually about 15 cwt.

The figures in these tables do not give the statistics of the whole crop, but of that part of it taken off between the 1st January and 17th July, 1869.

At D, from thirty to forty hogsheads were reaped in December, 1868, being the first part of crop 1869. A, B, C, E, have all been grinding since July 17th, and B, F, have canes not yet cut.

The truthfulness (and any value they possess) of these figures is not affected by their not giving the whole crop, for they do give *faithfully*, a record extending over the whole of an ordinary reaping season, and give within a few hogsheads the whole crop for the year.

The crop of A being all made into concrete, accounts for no molasses; the total of A crop will be upwards of 600 hogsheads.

The quantity of land on which the canes for crop 1869 has been grown, has so far been only obtained from the following estates, as under :—

F.... 108 acres Plant Canes
135 ,, Rattoons
gave
215 hhds. Sugar,
112 puncheons Molasses,
23 puncheons Rum, 18°.

243 acres.

26 acres of Plant Canes still to cut.

G.... 96 acres Plant Canes
95 ,, Rattoons
gave
220 hhds. Sugar,
110 puncheons Molasses.

191 acres.

The proportions to the acre are—F, ·884, or $\frac{9}{10}$ hds. per acre, nearly.
G, $1\frac{1}{10}$ hds. per acre, nearly.

This shows a difference in value of produce from these two estates (estimated per acre, of canes actually cut,) of nearly £800.

D..From 112 acres Plant Canes
117 ,, Rattoons
made
265 hhds. Sugar,
121 punchns. Molasses,
Or $1\frac{1}{6}$ hhds. per acre, nearly.

229 acres.

These hhds. have netted $16\frac{1}{2}$ cwts. at the Queen's Beam.

B....From 72 acres Plant Canes,
185 ,, Rattoons,

Total..257 acres, made 275 hhds. = 1·07 hhds. per acre.

E..From $92\frac{3}{4}$ acres Plant Canes,
$156\frac{3}{4}$,, Rattoons,

Total..$249\frac{1}{2}$ acres, made 280 hds. = 1·122, say $1\frac{1}{8}$ hds. per acre.

TABLE No. 4.

THE FOLLOWING TABLE SHOWS THE AVERAGE OF THE TOTAL PRODUCE AND VALUE OF AN ACRE OF CANES FROM EACH ESTATE, INCLUDING THE MOLASSES AND RUM.

CROP, 1869.

Estates.	Acres of Canes Cut.			Sugar, Molasses and Rum, valued as Sugar.			Totals of Crop including Molasses and Rum, valued as Sugar.	Total Value of each Crop.	Value of produce, from each Acre.			Average produce per Acre, including Molasses and Rum.
	Plant Canes.	Rattoons.	Total Acres.	Sugar.	Molasses. Puns.=Hhds.	Rum. Puns.=Hhds.	Tons.	Per Ton. £	£	s.	d.	Tons.
A	139	113	252	474 Tons Concrete	....	....	474	@ £18 10=£8769	34	16	0	1·885
B	72	185	257	Hhds. 275	210=70	15 = 7½	Hhds. 352½	Per Hhd. ,, £15=£5287 10	20	10	0	Hhds. 1·375
C	90	106	196	....	225=75	21½=11	....	....	......			....
D	112	117	229	265	120=40	28 =14	319	,, £15 = £4785	20	18	0	1·393
E	92¾	156¾	249½	280	130=43⅓	19 = 9½	332⅘	,, £15 = £4992	20	0	2	1·334
F	108	135	243	215	112=37⅓	23 =11½	263⅘	,, £15 = £3957	16	5	8	1·085
G	96	95	191	220	110=36⅔	Nil	256⅔	,, £15 = £3850	20	3	1½	1·343

On page 169 the yield is calculated on the sugar only, and does not include the molasses and rum. In order to get the exact proportion, the sugar value of the molasses, &c., has been ascertained. (See Table 4).

Dr. R. A. Smith in his analysis of cane soils from Antigua, in the first number, says, "it will be extremely interesting to see which of these soils brings the most valuable crops," we are now able to give some particulars of the crop 1869, on seven of the estates in that island.

We give the estates as A, B, C, D, E, F, G, they are in different parts of the island, and include the richest and best cultivated parts of it. On A, D, and E, the steam ploughs, (Fowler's two engines,) have been freely used. The estates A and E have heavy lands, that could be with difficulty kept in reasonable order until the steam plough was used, and they show the benefit of the thorough loosening and pulverizing that can only be obtained from the use of that instrument, the yield of these estates being nearly if not more than doubled in the last four or five years. The estate D has a strong heavy soil on a sub-soil of marl, the marl in many places cropping out to the surface and the canes planted in it, and with fair amount of moisture yielding well, the sugar being generally heavy and firm, and though often not a very good colour, always selling for a good price.

The lands of estate C are similar to A and E, but with some pieces of light lands from which it is sometimes difficult to make sugar, the syrup charring in the copper before the striking point is reached. The estate B has a great variety of soil chiefly of a light kind, the whole estate abounds in limestone.

As will be seen by reference to the tables, this estate B requires more juice per hhd. than any other of those named, while the sugar made is not so firm and heavy as some of the others, this is no doubt owing in part to the presence of an excess of salts in the soil, which act to neutralize the saccharine principle in the juice, and thus cause a double injury, by making it necessary to evaporate in some cases as much as 700 galls. more for a hhd., than other estates require to do, this can only be effected by keeping the liquor so much longer exposed to the fierce heat of the coppers, to the detriment of the sugar and great excess of cost in its production.

In the table No. 1 it will be seen that on March 13th, the estate E made 3 hhds. more from 6145 galls. less juice than were obtained on estate B. On March 20th, estate C from 33,000 galls. made 23½ hhds., whilst B from 23,275 galls. made only 11¾ hhds. or just one half the sugar made by C.

The difference is also strikingly shown on April 3 and April 17. It may be thought that differences in arrangement of works or coppers may cause this, but this is not the case, for the coppers on the different estates boil equally well, the juice is clarified in steam clarifiers of the same form, material, and construction, and the most thorough and scrupulous attention is paid on the estate B to the cleanliness of the boiling house and all connected with it.

As an illustration of the importance of this matter, it will be seen that if the juice obtained at estate B would have made sugar from the same number of gallons as estate E, the quantity obtained at B would have made 109 hhds. more than was actually obtained. The weight of canes required for 109 hhds. is about 1400 tons, and this weight has been cut, carted, ground and boiled, not only without benefit, but has really kept back the work of taking off the crop—injured the sugar made, by keeping it so much longer exposed in the coppers—and largely increased the expenses of the estate—as the wages for cultivation and all the expenses sufficient to produce 109 hhds. of sugar have been actually paid, though the sugar itself is not to be found either in the curing house on the estate or in the warehouse in England.

This sugar represents a loss of not less than £1500; a loss, which if not entirely, is at least in part preventible, and that such an analysis as Dr. Smith has given, if applied to this particular estate, would be almost certain to correct. This serious loss is one occurring year by year, sometimes more and sometimes less, but always a heavy loss.

There is no doubt that juice so easily injured as that given by canes on estate B should not be put in the open battery at all, except as a preparation for the vacuum pan, but should be made either into concrete by Mr. Fryer's Concretor, or into sugar by a vacuum apparatus, and the wastefulness inseparable from sugar making in the common open battery be avoided.

Comparing the juice obtained on estate B, with the concrete made on A; and assuming that if made into concrete, the same number of gallons would have sufficed (which may, or may not, be the case), the loss then is 193 hhds; and the value, at £15 per hhd., £2895,—much too large an amount to waste, if any of it can be prevented.

It may be worth consideration whether it would not be to the advantage of an estate to use a moderate quantity of coals, and apply to the land all the megass that can be saved by their use. It is not unusual to spend £400 in one year for foreign manures on one estate; if half this amount were spent in coals, and the megass applied to the land directly or as soon as convenient after leaving the mill; there is no doubt that great benefit would result from it, as a heavy dressing of this would protect the land from the scorching sun in dry seasons, and keep it cool and moist; whilst the slow decomposition of the megass would restore nearly all that had been taken from the soil.

The coal that would be most suitable is a quick burning coal with an intensely hot flame and burning to a white ash, coal of this description is found between Manchester and Liverpool, and could be shipped at a small cost per ton.

As the tables give much information in as compact a form as it can be placed before our readers, it is unnecessary to say more at present, but we may recur to this subject, believing it to be a vital one—few proprietors being in so favourable a position as to be able to lose from £1500 to £3000 a year by one estate from preventible causes.

[The writer of the above article says in a private letter to the Editor—"The tables sent herewith were not compiled with any view of publication, but simply for private information. They have been very carefully collected, and, as you will see, with much labour brought into their present form; for, although there is no figure added that is not to be found in the boiling-house diary of each estate, the arrangement of these diaries is widely different from that I have adopted, my object being to present all the salient points of the case in a simple, but forcible manner."

CANE CULTIVATION IN GUADALOUPE.

From the "Journal des Fabricants de Sucre."

We have before alluded to the disturbances which the abolition of slavery would produce in Cuba, and to the transformations to which the sugar manufacture would then have to submit, in that colony, of which the present advantage is entirely in the number of hands which the planters have at their command, and the power of the indefinite extension of their cane fields. In Cuba, if a cane piece is exhausted, its owner leaves it and cultivates another at a distance. This system, that of extensive culture, is convenient in a country where there is plenty of land and plenty of labour, but it has the disadvantages of dispersing the forces, of increasing the general expenses, and of compromising future prospects. It is the culture of new countries, and it was formerly that of our colonies which slavery, and the customs consequent thereon, corrupted and ruined for a long time.

In Guadaloupe and Martinique, an admirable economic transformation is in progress. The *culture* is, as we know, being separated from the *manufacture* (of sugar), and the latter (it seems probable) will be entirely absorbed into the central factories which are provided with the most powerful and perfect machinery; but agriculture remains, up to the present time, outside or behind this movement, and yet, it also, ought to concentrate its forces and diminish its expenses. The central factories can only produce good results when supplied with material in proportion to their manufacturing power; and only improved cultivation will supply this material.

To labour better, to manure better, to weed better, to concentrato the forces instead of dividing them, such is the problem that an inhabitant of Guadaloupe, M. Pauvert, has tried to solve, and of whom, M. A. Valléi, our esteemed confrére at Point á Pitre, who calls him "the model planter," has just made known the encouraging example. "In 1849, M. Pauvert," says M. Vallei, "was simply a tenant, one that we call here 'a sucrote,' who produced a hundred casks of raw sugar."

"In 1869, he is the proprietor of four beautiful sugar estates, which produce nearly 2000 casks of white sugar. These figures are eloquent because they are true; all the world here knows it, and the Customs of Point á Pitre will testify to the fact."

"How has M. Pauvert arrived at this magnificent result? By a very simple process, so simple that we are now astonished that no one thought of it before him, a process which may be reduced to the following axiom: *If you wish for a large crop of sugar, plant very few canes.*"

"We know the cost in money and time of a hectare of plant canes, as regards the mere weeding they require, the animal and the manual labour, and the care needed for long months that the weeds do not choke the plants."

We know all the difference which exists as regards time and money in the care required by a hectare of rattoons. From the day when M. Pauvert first had a sugar estate on his hands, he has applied himself to diminishing the area of plant canes, and to manuring his rattoons abundantly, to make them in a manner perennial; it is thus that he has come in 1869, to make 2,000 casks of sugar with only 25 acres of plant canes, and all the rest rattoons."

"Here, a question is sure to arise—two thousand casks of sugar it will be said is truly a magnificent result; but it is important to know how many hands M. Pauvert employs."

"It is easy to satisfy the reader's curiosity. M. Panvert obtains two thousand casks of sugar with only two hundred Indian and

African workers; it is necessary to say that all these are healthy, and that it is very rare for one to be in the hospital."

"M. Pauvert's mules and oxen are as fat as bacon, and never die but of old age, whilst the numerous troops of cows, of sheep, of pigs, of goats, produce a quantity of manure which reduces very materially the amount expended in guano."

"It is unnecessary to remark that M. Pauvert has no 'adherents,' that he manufactures only his own canes; 326 hectares (805 acres) have given him a return of more than 5½ casks to the hectare (1·1 tons to the acre); it must be observed that his is a Bourbonne factory, and that he does not use char, so that his return is less than it would be at one of the great central factories."

EXTRACTS FROM THE BULLETIN OF THE AGRICULTURAL AND INDUSTRIAL SOCIETY OF COCHIN CHINA.

(C. 1 No. IV.—pp. 29.)

(From the French.)

Note on the Agricultural and Industrial Establishments of the province of Bien-Noa; Sugar Manufactories and Cane plantations.

Respecting these we can only report that the system of cultivating the cane is wretched and the process of extracting the juice deplorable.

All is primitive and imperfect; all is yet to be made; and we shall have to struggle a long time yet against the routine of the sugar manufacture of the people of Annam. Can nothing be counted on from the imitative nature of the Asiatic? We think not; our expectations must be very modest. We must strive to induce the people of Annam to grow better varieties of cane, and to take more care than is known at present. We must not dream of seeing them using the perfect machinery of other colonies. The time has not yet come, and however intelligent the Asiatic races may be, we are obliged to own their great inferiority when employed in mechanical operations. It is then needful to look to the European colonists to create sugar manufactories worthy of the name and capable of enriching the colony, leaving to the aboriginal sugar makers the simple role of planters. All proves what we assert, their ignorance and the cost of production which is so high as to admit of the importation of sugar into Cochin China. Meanwhile, this high price of 1 fr. 10 cent. per kilo. is not justified by the dearness of manual labour, nor by the cost of cultivation, nor by the interest on the plant of the factories. We might enter the imports in figures, but as the commission has been able to prove, the quantity of the fields declared by the planters is so small compared with the quantity which they cultivate in reality, that it becomes insignificant.

The high price, then, depends on the wretched process of manufacture and the bad species of cane, which is degenerated, small, woody, gives but little juice, extracted with difficulty, whilst it is sufficient to see the rollers employed in its extraction to be convinced that they cannot give nearly half the juice obtained by the machines actually used in other colonies.

It has been attempted to be proved that the cane of Cochin China is not subject to the disease. This is an error. It has been pretended that the sugar extracted from it was superior to that of other canes. This also is an error. * * The quality of the sugar depends on the process of manufacture not on the cane itself. The crystallizable sugar is the same in all canes, and in all the vegetables which contain it. The formula $C^{12} H^{11} O^{11}$ does not vary, the quantity only varies, also the quantity of substance contained in the juice, such as colouring matter, mineral salts, albumenoids, and uncrystallizable sugar or glucose. This last is contained in all canes in very slightly varying proportion, but in greater quantities when the cut canes are unripe or exposed to the air or the sun, which constantly is the case in the cane fields of Annam. We thus see why the 10,000 hectares or so which are cultivated in the province of Bien-Noa enrich neither the proprietors nor the colony.

Two qualities of sugar are produced: the first, which is a beautiful cassonade (moist sugar) sometimes very white, costs as we have said, 1 franc 10 cents per kilo. (6½ per lb.) It is only made by the rich proprietors of the neighbourhood of Bien-Noa and of Canurgen. In obtaining it they make use of the dark and slimy clay which is found along the river of Bien-Noa.

The second quality, or black sugar, which is made in great quantity, is simply the cane juice boiled sufficiently to solidify it by evaporation. It is generally sold in the brown stone pipkins. Some makers boil it further, and make small oval loaves of it.

THE POPE, A SUGAR MANUFACTURER.

The "Holy Father" takes great interest in the factory he has established at Castellanio for the extraction of sugar from beetroot, a process hitherto unknown in Italy, and has presented some of the sugar to all the officers of his private ante-chamber. The sugar factory divides his attention with the council and the exhibition.—*Correspondent of a London Paper.*

A GLANCE AT THE SUGAR INDUSTRY OF MAURITIUS.

From the French.

Communicated to the "Commercial Gazette."

Just when the colony, for awhile almost sinking under the commercial crisis, begins to recover itself, and slowly, yet surely, to make for port, it is not, perhaps, out of place to take a retrospective glance, and trace the progress of our principal industry, and observe, at the same time, what is passing around us, from which we may draw some useful lessons.

Not many years since, the culture of the precious plant from which all our resources are derived was still in its infancy. Some factories rose here and there, at rare intervals, throughout the

Island. These were mostly small huts covered with the leaves of the almond or aloe, which at first afforded shelter for man, and in which a little later, machinery was placed, as rude as defective.

We ourselves remember seeing once at the house of the Hon. M. C. a cane mill of this period. We can scarcely express the astonishment we felt. It is, in fact, difficult to comprehend how our fathers could make use of such machines; and the imagination shrinks before the prodigies of patience and strength that were, without doubt, necessary, in order to arrive at a satisfactory result.

Yet, however, the proprietors considered themselves very successful; and notwithstanding all the imperfection of their means of manufacture, they enriched themselves by degrees. One may truly say that those were the golden days of agriculture; one is tempted to doubt, when one is now assured, that a cane piece has produced from ten to twelve thousand pounds (avoir.) per acre. However, it is quite correct and easily explained; the soil which had not been long tilled was entirely new, and what was given into its bosom, it rendered back a hundredfold.

Then our fathers did not work as we do. Devoted to one system of culture, they knew nothing of all those manures on which no two people are agreed, and of which much of good and bad is said; and did not need to have recourse to them to give the land a fictitious fecundity. Knowing well that nothing comes to those who look for too much, they were content with modest revenues, which, accumulated, became fortunes.

This was pushed so far that the planters, finding in the sale of their produce, prices sufficiently remunerative, did not even take the trouble to extend their plantations.

Beside, then, some cultivated fields, there were on all sides only immense unoccupied plains. Magnificent forests extended as far as the eye could reach, and seemed to give a perpetual challenge to the woodman.

Gradually, however, the little colony saw the number of its inhabitants doubled and trebled, the circle of relations was enlarged, and the needs of the community augmented. Then these trees of a hundred years which covered the soil, fell one by one, and the denuded plateaus became immense fields, on which the cane flourished magnificently. Whilst agriculture was thus greatly extending, skilled mechanicians added every day some new improvement to the machinery. At first they worked over the open fire, or, according to the common expression, "*à la Malartic*," when a man of rare intelligence, Monsieur Wetzell, invented the machine which bears his name. After him there came Messrs. Pontifea, Faucet, and Manlove, who added new and important improvements to the industry.

To-day, thanks to them, hardly any of the juice is lost, and we are able to extract from the cane the greater part of the saccharine matter which it contains. A valuable discovery has just lately made an immense advance in the manufacture, we allude to the process of Dr. Icery, of which no one doubts the great advantage. It seems, then, as though the inhabitants had attained the *ne plus ultra* of improvement. It is not so, however, and the whole sugar industry yet leaves much to be desired. The culture is not what it should be in a single point of view—the manufacture is yet imperfect, and the results obtained are far from satisfactory.

We need not recall the involved positions, the fortunes swallowed up—in short, all the disasters which have lately befallen the sugar industry. All the world knows the enormous cost which has been incurred to produce, in many instances, only despair and ruin. How many planters have we seen during the last year dragged from a position of affluence to the most extreme misery!

We have not yet attained perfection, and there is still room for numerous improvements. It is sufficient to point to them, to call to mind that every day gives birth to new inventions, and that science is continually discovering to us some of her most precious secrets.

In the midst of successive improvements in the manufacture of sugar, the culture of the cane seems to remain *in statu quo*. We must note this fact—that in proportion as the sugar industry has advanced in the path of progress, the cane appears to have retrograded. Yellow and thin, it only thrives with the utmost care; and it appears as though the earth had rebelled against the domination of man, and refused to yield her increase. To what can this be attributed if not to the exhaustion of the soil and to the almost general droughts of these last years?

A certain number of planters are beginning to comprehend the necessity of watering their cane fields, to remedy the evils occasioned by want of rain, and are in earnest to put irrigation in practice. But others cannot decide to depart from the way of routine in which they have been accustomed to march, and think they have done great things when, at the cost of immense sacrifices, they double the dose of guano which they have granted to their fields. But all, in presence of the beauty of the present crop have felt hope return to their hearts; they contemplate their luxuriant cane fields, and seem to forget everything else in the midst of their dreams of bounty and richness.

We fear we must recall their attention. Who knows if our plantations will be thus favoured in the future? The lesson of the past indicates the course we should follow. Let us then make an effort to profit by the experience of the past, which we have acquired at such a cost.

We have already written, and we repeat it, that, notwithstanding the progress already made in the sugar industry, there is yet great room for improvement.

We will put aside for future consideration questions relating to machinery for the manufacture of sugar. For the present we only purpose to consider its cultivation proper; and, whilst pointing out the evils which environ it in Mauritius, to indicate the means of remedying them to a certain extent.

We have already spoken of the actual state of the cane; if there is a point on which all the world is now agreed, it is that after many crops the soil becomes exhausted, and, consequently, does not possess sufficient of the elements of production. To obviate this as much as possible, some use guano; others let the ground lie fallow.

We have nothing to say against the first, so many men of the highest intelligence have vainly endeavoured to decide the question that we dare not enter into it after them.

As regards the second, we shall merely say of those who practise it that they do not march with the times.

Modern science has recognised that the system of fallowing, which formerly was established on incontestable principles, is one of complete inutility. Instead of leaving the soil to lie fallow, with no gain to himself, the occupant may more profitably, make a change to a crop which needs little outlay, and tends thus to diminish the general expenses of the property.

Such are the tapioca, which affords excellent food for mules and cattle, the potato, the haricot, the pea, &c., which form part of the food of man. A great number of planters have returned to this kind of agriculture, which was that of our fathers, and every day their example is being followed by others.

But in our opinion there are many more efficacious means of restoring the soil to its pristine fertility, some of which we are about to point out to the reader.

To begin with, we must say a word in favour of irrigation, a subject on which certain inhabitants of the island have given expression to some monstrous scientific heresies.

Irrigation is a necessity in hot and dry regions. It is indispensable for coast lands. We have heard it affirmed by some persons that irrigation does more harm than good to the cane, in that while it remedies the drought, it deprives the soil at the same time of all the humus contained in it.

It is scarcely needful to say that this is entirely without foundation. We may admit that it is correct sometimes in Europe, where irrigation occasionally becomes inundation; but here, the water only reaches the plantations little by little, by filtration, and it cannot but fertilize them. We refer those of our readers who doubt it to the excellent treatise on irrigation by Pareto; they will be convinced by it that we are in the right, and that irrigation is the only means which is at our command to obviate the droughts which so often desolate our fields.

We must avow, in the face of scientific opinion, that we are not great partisans of guano, and, therefore, leave it in doubt.

Besides, the great quantities which have been shipped the last few years have almost exhausted the supply; and in the course of time, sooner, perhaps, than is expected, agriculture will no longer possess this resource.

It is, then, absolutely necessary, that the colonists should prepare themselves to meet this probable failure of guano.

More fortunate than our fathers who had only their own common sense and experience to rely on, we have for our guidance the admirable works of modern chemists; we know that certain manures are able to fertilize and improve the ground, and furnish it in a certain measure, well understood, with the elements which it needs:—azote, phosphate of lime, potash, &c., &c.

Some months ago, if we remember correctly, a physician of the first grade, an experimental chemist, M. P. Bories, wrote from the Sister Isle (La Reunion), to our Chamber of Agriculture, that he was at the service of the inhabitant of Mauritius to analyse their soils; the offer was tempting and deserved consideration; but, however, it found no response, and not a voice was raised in its favour.

There is yet time, and the interests of the inhabitants demand that they should have recourse to the scientific knowledge of Dr. Bories or some other chemist. They might thus ascertain what manures they ought to use in order to restore to the soil the inorganic substances of which it stands in need. For it is unnecessary to say that all manures do not equally suit all soils. What is truly curious, and what we have remarked on a great many estates is, that this fact is not even recognised. How many times has the end in view failed from neglect or ignorance of this principle!

It is with regret that we state it, but this question appears to be one of entire indifference to agriculturists. To cold stiff soils they give expensive watery manures, when, on the contrary, they should supply them with that warmth and porosity in which they are deficient by means of stimulating manures.

By means of analysis this defect would soon disappear, and good results would ensue.

We have now to give only one last word of counsel.

It is not sufficient to use for manures the sweepings of the cattle sheds and stables, the dry straw, megass ash, &c. There are still a great number of matters—such as sea weeds, for example—which are exceedingly beneficial.

However large an establishment may be, it cannot supply enough manure for its own soil. We think that it would not be difficult for the planters to arrange with the municipal authorities for the utilization of the refuse of the towns, the cleansings of the port, the dead animals, damaged merchandise, &c., &c.

The goods department of the railways would deliver this refuse at a nominal charge for carriage.

The agriculturist could then compose on his estate, manures, which analysis showed that his soil required.

If we are not misinformed, this system has already been tried on two or three estates. That of "Bassin," which belonged to the late Honorable Leon Amand, is the first on which the system was commenced, and several tons of all sorts of refuse procurable from the docks and the town were daily carried thereto. Consequently, the canes on this estate present a magnificent appearance, and give promise of a yield far superior to that of the most favourable of former years.

Our subject has carried us further than we intended, we must conclude. We hope we have been successful in arousing the attention of the planters, and that our suggestions may be of service to them.

FROM THE "JOURNAL DES FABRICANTS DE SUCRE."

We have had news from the great Factory of Arboussier at Guadaloupe, which was ready to commence operations on the 5th of April, but which did not get to work regularly till the 25th. It has finished its season with part of its copper machinery not fitted up, and at no time has it been supplied with sufficient canes to keep its mill regularly going. It has received over 17,000 tons of cane, and made 3,000 casks of sugar, being a little over 8 o/o, but the syrups from the lower products not being finished, these figures are only approximate.

3,000 casks of sugar, remarks M. Nallee, who furnishes us with the details, is assuredly a small quantity for a factory such as d 'Arboussier, which could make 12,000, but it is considerable when one remembers all the difficulties attendant on the starting of such gigantic enterprises; not to speak of the drought, and of the want of sweet water at the commencement, which had an unfavourable influence on the yield of the cane.

Every thing leads us to hope that the next season will be very superior.

The actual "adherents" of the works would have provided nearly 36,000 tons of cane if the drought had not supervened, which rendered useless the expenditure incurred in view of the production of this amount.

For the rest the organization of credit established in connection with these "adherents" gives the certainty of a production which, in the future, must go on increasing.

The Sugar Company at Point a Petre does not confine itself to receiving canes in its scales or lighters, and in paying the price fixed by the court for the month. It also gives, when needful, sums necessary for the purchase of manure and of animals, to meet the exigencies of the cultivators; and it is in this credit, largely given, that the true reason must, in future, be sought for the great increase in the cane culture of Guadaloupe; and for this reason many fields which last year were fallow will be planted with cane for next year's crop.

From the Iberia Journal (July 17.)

On Monday last we were invited to notice the workings of the new apparatus invented by Mr. Escudier for the manufacture of sugar. We could not do otherwise than congratulate the inventor on this new method of kettles, the manner in which they are adjusted is far superior to any which have appeared up to the present time. By this new process of manufacturing the work is simplified in a surprising manner, as a single person can easily attend to all the kettles at the same time. By means of faucets or stoppers, the cane juice and syrups pass from one kettle to the other without being obliged to use buckets as is the case with the old which necessitates a loss of time, and which is much more difficult, in transporting the syrups from one kettle to the other. By means of pipes which encircle the kettles, the skimming is performed of itself, and at the moment of ebullition the skum falls into a bucket designed for the purpose and is immediately placed in the kettles again to be reboiled, so that there is no waste whatever. Several experienced persons were present to witness the operation of the apparatus, and all predicted for Mr. Escudier a sure success; the only thing which we might find fault with was the slowness of the large kettle in arriving at a boiling state, but that might have been owing to a defect in its construction which would be very easy to remedy. We are certain that with a few improvements Mr. Escudier would have a perfect invention. This new method will be used this year on a plantation situated at Fausse Pointe, and any person who desires to witness its operation and appreciate its advantages will have an opportunity of doing so.

Mr. Edward Beanes has called our attention to the following letter which he has written to the editor of the *Produce Markets' Review*, relative to the use of Monosulphite of Lime in sugar making:—

Cordwalles, Maidenhead, Sept., 6th, 1869.

Sir,

In a communication to the *Overland Gazette*, dated 30th July, Mr. Icery states that I had to sustain an action-at-law in Cuba for having put in practice a process somewhat similar to that of a Mr. Stowart, of Louisiana. In this he has inverted the truth; it was I who entered an action against a Mr. Marcelin, for having put in practice my process (of monosulphite of lime, manufactured in the juice, for which I had a patent) after a lengthened defence on the part of Marcelin, a legal decision was given against him, and he left the country in consequence, in order to escape payment of law expenses. Could he have shown—and he had lived many years in Louisiana—that Mr. Stowart, or any other, had put in practice the same process prior to the date of my patent, the result of the suit would have been somewhat different. Mr. Icery also gives his view as to why I adopted the process of using phosphate of ammonia in conjunction with bisulphate of lime, &c.; but as I have shown the proposition on which it is based to be untrue, his assumption is valueless. It may be satisfactory to some to state, that my reason for the use of the phosphate of ammonia (not sulphate, as given,) was with a view of removing every trace of monosulphite of lime from the sugar after it had fulfilled its object: I was induced to do this from the disinclination on the part of sugar refiners to purchase sugar containing monosulphite of lime, on account of the injury their animal charcoal received from its use. Mr. Icery has already consulted me on the subject of my process for purifying animal charcoal. I would advise him to think seriously about its adoption (especially as he will be free from royalty, as I have no patent in Mauritius) because he will very soon require it. If you can find space for the above, and will kindly give it insertion, you will confer a favour on

Sir, your obedient Servant,
EDWARD BEANES.

MARKET REPORTS.

From the "Journal des Fabricants de Sucre."

The importation (into France) of sugar from the French colonies up to date has been 47,336 tons, against 59,478 to same period in 1868, being a decrease for the present season of 12,142 tons; and the imports of foreign sugar have been 68,523 tons, against 67,594 tons, being an increase of 929 tons. The decrease from the colonies is chiefly from Guadaloupe and Martinique. The increase of foreign is in order in importance from Belgium, the Low Countries, Mauritius, and Egypt, which has been nearly balanced by less transactions with Cuba, Brazil, and divers other countries. The deficiency from our own colonies has not been quite counterbalanced by the increase of foreign importations.

The importations of foreign molasses from the Zollverein, the Low Countries, Belgium, and other places, has very greatly increased, the figures being 23,774 up to present time this year, against 8,047.

The exports of raw beet sugar amount to 13,986 tons, against 18,250 tons in 1868, and 11,742 tons in 1867. The re-exports of colonial and foreign sugars show an increase of 2,524 tons over last year.

The exports of refined are 55,616 tons, against 45,578 tons in 1868, and 45,678 tons in 1867, an increase of 9,938 tons over last year, which increase has been in order of importance to Turkey, England, the kingdom of Italy, Austria, Greece, Belgium, Hungary, Rio de la Plata, Chili, Algiers, and Russia; whilst there has been a falling off in the exports to Switzerland, Sweden, The Roman States, the Hanse towns, and other parts.

Holland exported in the first six months of the present year 42,641 tons, against 37,870 tons in 1868, and 35,899 tons in 1867. Belgium exported during the first five months of the year 4,403 tons.

Deducting the quantity of raw sugar cleared and refined under bond and exported, calculated at 85 per cent., we find that the consumption in the first seven months has been in France 157,542 tons, against 152,156 tons in 1868.

In England the consumption has been about the same as last year—*i.e.*, 346,228 tons, against 346,199 tons.

The stock of raw and refined is 109,616 tons, against 113,748 tons last year.

The general stock in the principal markets of the world up to the 31st July was 417,966 tons, against 406,105 tons in 1868, and 435,799 tons in 1867. Otherwise, an increase of 11,861 tons over last year, and a decrease of 17,883 tons from 1867.

The most striking fact to be noted is the general reduction in stocks, which, during the month of July, suffered a diminution of 36,688 tons, consequent on small arrivals and renewed activity in the deliveries in Europe, as well as in the United States. The question arises whether this great deficiency can be made up, and whether the high price of sugar will call forth unlooked-for supplies.

From the Havana Evening Report, September 3rd, 1869.

SUGAR, Clayed.—There has again been a lively business done in this staple throughout the week, the favorable advices per cable from abroad and higher values in London having renewed the disposition of buyers to operate largely, and these have freely granted the prices of 8¾ @ 9 rs. ⅌ arrobe for D. S. No. 12 of current classes for the North European and United States markets, to which our last quotations have advanced.

The firmness of some holders even at said rates, the scarcity of suitable descriptions and of tonnage, having again curtailed transactions, and the amount of this week's sales has thus been only about 30,000 boxes, which is the total of last week.

There has been little done comparatively in fine sorts suitable for Spain and other South European markets, but they continue scarce and firmly held.

The receipts of sugar at the warehouses of this port, from 1st January to date were, 1,313,300 boxes, against 1,399,000 in 1868.

The clearances from the same were, during the same period, 1,102,000 boxes, against 1,169,000, in 1868, and the stock yesterday was reduced to 235,367 boxes, against 276,000 in 1868, and 210,000 in 1867.

The exports from this port and Mantanzas this year show a decrease of 40,777 boxes as compared with 1868, and an increase 171,969 boxes as compared with 1867.

From Licht's Monthly Circular.

"The latest news places the present crop in Mauritius in a very favorable light, both as regards extent and quality, the yield is estimated at 135,000 tons. The delay in the cane harvest in Java has already been noticed in a former circular. For the rest, with the exception of Cuba, there is a prospect of increased production this year from nearly all the colonies. But against this must be placed the situation of the 'Pearl of the Antilles," the largest and most important of the tropical sugar countries, not merely that the political state and prospects of Cuba are so uncertain, but the attention of the planters will be more taken from their estates than heretofore. During the present season planters sent their sugar as quickly as possible to Havanna and Matanza, for safety, whence it happened that the exports from thence to the middle of July showed an increase and the stocks but a slight decrease, whilst complete statistics from all the ports in the island afterwards showed that to the end of June there was a deficiency of 50,000 tons as compared with last year, which deficit will by this time have reached still greater dimensions, as by the middle of August it had mounted to 22,000 tons in Havanna and Matanza alone. Thus, the earlier intelligence from Cuba has proved correct in estimating a considerable deficiency, and it and it further shows that a still greater for next season is more than probable."

Stocks of Raw Sugar in the Chief Markets of the World, in Thousands of Tons, to July 31.

	1869.	1868.
United Kingdom	107	110
France	36	59
Holland	49	45
Zollverein	5	4
United States	156	115
Total	418	406

Consumption in Europe and United States for Year ending July 31.

	1868-9.	1867-8.
Europe	1239	1168
United States	401	407
	1640	1575

SUGAR STATISTICS—GREAT BRITAIN.

To 18th Sept., 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1869.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	21	3	1	12	37	62	79	9	11	41	140	170	78	9	13	37	136	134
British East India	6	4	..	..	9	4	9	5	..	..	14	3	9	5	..	..	14	8
Mauritius	2	..	..	..	3	5	6	1	5	4	16	33	10	1	5	5	21	34
Cuba	10	5	2	23	39	43	14	12	18	52	96	108	10	10	17	41	78	78
Porto Rico, &c. ..	3	3	..	1	6	8	4	9	1	2	15	15	3	7	1	2	13	11
Manilla, &c.	38	8	..	1	46	41	23	14	1	2	40	33	14	17	2	1	34	32
Brazil	1	14	2	2	19	22	1	28	12	13	55	51	1	30	11	15	57	46
Beetroot, &c.	1	..	..	1	2	1	10	3	1	10	25	30	12	3	1	10	26	35
Total, 1869 ..	81	35	5	39	160	185	146	81	49	125	401	443	137	82	49	110	378	378
Total, 1868 ..	81	47	7	50	25decrease		158	84	46	156	42decrease		144	74	43	117	slight increase	

STATE AND PROSPECTS OF THE SUGAR MARKET.

At the beginning of the past month, sugars generally were firm, with an advance of 6d. for better descriptions of West India, but for the last week or two the market having been dull, the advance has scarcely been maintained. Importers and holders have confidence in the future prospects of the market, and are not inclined to give way further, whilst the trade are not disposed to increase their stocks, so that only a limited business has been done. Pieces and crushed have lost the advance obtained on them a month ago, there being no longer any scarcity of water at Greenock, and the markets in other places being well supplied.

The stocks of sugar in the United Kingdom and in Europe continue to show a decrease as compared with last year, whilst in the United States there is still a large surplus.

The state of Cuba presents no new feature, the present crop has proved deficient as compared with last, but considerably in excess of that of 1867. The beet crop on the Continent is not likely to realize the anticipations at one time entertained, still the yield of sugar is estimated at 60,000 tons more than last season, which increase must be taken into consideration in any calculation as to the prices of sugar beyond the next month or two.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

THE

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☞ The writers alone are responsible for their statements.

ON A FREE BREAKFAST TABLE.

By Leone Levi, F.S.A., F.S.S., L.L.D.,

Professor of Commerce and Commercial Law, in King's College, London.

A desire has been expressed that we should once more inquire into the soundness of our commercial and financial policy, and certainly it does not fear the fullest scrutiny. What we are sure of is—that there is much yet to be done in the way of freeing our trade and unshackling our enterprise. True, we have not been idle. From the memorable year when Sir Robert Peel, in obedience to those economical laws which he could withstand no longer, revolutionized the course of legislation by reducing, instead of increasing, our taxes, with a view to an improving revenue, till this very year, we have steadily and persistently pursued one continuous policy of reform. And for twenty-five years and more we have been reaping the fruits of that policy in an increasing trade, expanding resources, and a widely-diffused, general prosperity. But we must not rest where we are. The best mode of silencing the faintest ejaculations of those who from the midst of the blessings of free trade—in so far, at least, as we have realized that name, still linger after protection and reciprocity—is just to advance undistracted and unrelenting on the way of reform, and with such men as Gladstone and Bright at the head of our administration, we may well anticipate that we shall ere long be summoned to consider measures of a bolder character than we have yet attempted, besides which even the suggested gift of a "Free Breakfast Table" may sink into insignificance.

It was wrong at its very inception to draw any revenue from the trade of the country, and to intercept those channels of wealth, which alone gives the means of satisfying the wants of the State. Place on the shoulders of the tax-payer as heavy a burden as you please, but let him have full freedom to earn the wherewithal he shall pay the taxes of the country. Moreover, it might have been a necessity in olden times to seize whatever could be got in the shape of taxes, and to take pledges that this or that article should not be used or touched before the tax was paid; but we trust we have passed the era of material guarantees in matters of taxation. The nation knows full well that the State has to meet a given annual expenditure, dictated—not by the caprice of the Sovereign, but by the exigencies of the country. The nation knows that the amount so required ought to be fairly contributed by the entire community in just proportions, and with proper regard to persons and wealth. What is wanted is a system of taxation strictly in accordance with economic laws, yet sufficiently simple and capable of commending itself to the understanding of all classes. Let this be suggested, and there will be no difficulty in obtaining for it universal acquiescence.

Without, however, launching into any bold speculation, let us see what are the bearings of even such a limited reform as is contemplated by the total abolition of all duties on sugar, coffee, tea, and cocoa: for bread and butter are, we are happy to say, now quite free, the last trace of the corn laws having been obliterated only last session. Let us consider the question from its financial aspect—the ways and means of the matter, and let us endeavour to appreciate its possible effect on the commerce of the country. There is nothing, indeed, in the present position of our finances to warrant any great inroad on the revenue. A few years ago we were basking under the sunshine of a handsome yearly surplus; but of late the scales have completely turned, and what with the great war in

Germany, and what with the expedition to Abyssinia, our hopes of reductions or reforms have been quite defeated. It was only by a happy stratagem that we have been saved from a worse issue in the present financial year. How can we muster courage, under these circumstances, to urge the abolition of an important part of the revenue? We do it simply because we have by this time had ample experience that a deficiency in the revenue is not of itself a sufficient reason for our standing still. In the very midst of a heavy deficiency Sir Robert Peel introduced his great Budget in 1842, and it was in the face of another deficit that last session the Chancellor of the Exchequer made a wholesome clearance of many taxes on trade, locomotion, and insurance. And we imagine, that if we were to wait for the day when we shall have an exchequer overflowing with wealth, before any further great reform is attempted, we would have no chance of making any more advance whatever.

At one time, the Customs produced nearly the half of the revenue, but it is not so now. Whilst the revenue has been greatly enlarged of late, the Customs remained stationary for many years, so that we are less dependent on that source of revenue than we once were. A still greater change has been made in the number of articles subject to Custom duties. Some twenty years ago, upwards of one thousand articles figured in the tariff. Even before the Treaty of Commerce with France was concluded in 1860, there were 428 articles separately enumerated and chargeable with duty. By that treaty the number was reduced to 142, and since then the tariff has been still more simplified. In fact, at this moment, the bulk of the revenue is obtained from about a dozen of articles, some of primary necessity, and some of widely diffused luxury. Several articles, such as arrowroot, rice, sago, starch, were liberated last session with the abolition of duties on corn and meal, and though other articles are still on the tariff to counteract the excise duties on spirits and malt, or the duties on sugar and British chicory, the gross amount received from them is very trifling. Taking the Customs' revenue for the year ended 31st December, 1868, the sum was distributed as follows:—

Sugar and Molasses	£5,744,823	
Coffee	382,626	
Tea	2,672,978	
Cocoa	26,453	
Chicory	110,073	
		£8,936,953
Spirits	4,333,427	
Wine	1,521,193	
Tobacco and Snuff	6,578,751	
		12,433,371
Corn	864,097	
Fruit	434,335	
Other Articles	24,751	
		1,323,183
		£22,693,507
Deduct drawbacks and repayments		281,724
		£22,411,783
Charges of Collection		793,413
		£21,618,370

And if we deduct from this amount the duties remitted by the act of last session, we cannot calculate the produce of the Customs, except in so far as it may result from an increasing consumption, for next year at more than £20,500,000; distributed in the proportion of 60 per cent. from spirits, wine, and tobacco, and 40 per cent. from sugar, tea and coffee, cocoa and chicory, the articles belonging to the breakfast table. If, therefore, we wish the duties on these articles remitted, we must prepare for a loss to the revenue, amounting probably to about £8,000,000 per annum. Can such a sacrifice be safely advocated? Is there any immediate chance of lightening the burden of the nation to that extent in order to enable us to make this great reduction?

Our expenditure has, it is true, been unusually high of late. Would that we could calculate on any early material reduction. All the animated discussions on Mr. Cobden's proposition to curtail it by £10,000,000 have proved of no avail, and we are still paying yearly enormous sums for the maintenance of the army and navy, forgetting the sound axiom that "an armed peace is war." Were indeed a reduction possible in these services, the problem before us would be easily solved. But if no reduction is practicable, how can we obtain such a reform? Certainly it will never do to impose other taxes in lieu of those in existence, since probably the exchange would not be for the better. Our hope is that if we cannot effect at one time the entire reduction of £8,000,000, we may yet realize a limited surplus from year to year, and save something even in the next financial year.

Looking then to the future as well as to the present, and assuming the possibility of dealing with the subject—the first question to ask is, would it not be better in case of any surplus to go on reducing the National debt, by making further conversions of permanent into terminable annuities rather than abolishing or reducing any taxes? This appears to be the policy of the United States of America at this moment; and much may be said in its favour, but I do not think the reduction of the debt should stand in the way of substantial reforms on our fiscal system. The two objects must go hand in hand. But there is yet another alternative. Should we prefer the abolition of the duties on sugar, coffee, and tea to the remission of any other tax, and even the income tax? Doubtless, the repeal of the malt duty, or the abolition of taxes on wine, spirits, or tobacco, would be most objectionable, if for no other reason than because they offer at least some check to the vices and excesses which these articles occasion. The income tax, bad and unequal as it is, could not well be spared, since it acts as it has has been well expressed as the safety-valve of the fiscal system. Many other taxes there are which we would doubtless like to see abolished, but the great advantage of abolishing the duties on sugar, tea, and coffee is, that, besides relieving the people of the burden of the tax, the reform would subserve the still more important object of liberating a large industry from the trammels of heavy duties, of stimulating the resources of the sugar-growing colonies which have for years striven hard to compete, certainly on no equal terms, with Cuba and Brazil, and of developing the large and important branch of trade carried on in the articles of the breakfast table. It is on these and other grounds that I would prefer this method of dealing with any surplus to any other, and I do trust that ere long the subject will form a leading feature of the national budget.

It must be remembered that if the collection of the duties on tea, coffee, and cocoa is simple enough, that of the sugar duties is by no means so. A few years ago a fierce battle was fought between the advocates of a uniform and a graduated scale. The advocates of the uniform rate argue that a differential scale of duties operates as an obstruction to improvements in the manufacture, practically checks the supply of refined sugars from India, and thereby reduces the choice of good sugars; the advocates of the graduated scale asserting that their plan is absolutely fair, since it levies the duties not on the raw material, including as it does sand and other deleterious substances, but on the sugar contained in it, and that in just proportion to the saccharine or crystallizable matter contained in the sample. At one time sugar was refined in bond, but it is needless to observe that the refiner was not well pleased with being continually before an excise officer, that much danger accrued by it to the revenue, and that a good deal of vexation was caused from the constant interference with the process, especially where the operation is a continuous one, the sugar melted one day remaining for weeks it may be, under manufacture. Those who have had experience with the excise in the manufacture of soap, or bricks, or glass, know full well what it is to be fettered by excise regulations.

The drawbacks on sugar exported have given a good deal of trouble. A treaty was concluded in November, 1864, with France and the Netherlands for regulating by common agreement the international questions relative to the laws affecting sugars, and especially the drawbacks granted on the exportation of refined sugars. But the regulations are very complicated, and it is not likely that any such regulations will really be effectual in establishing a system really just and equitable to British and foreign refiners. It was said that the refiners in this country would suffer by the abolition of the sugar duties, since, if there were no duties, grocery sugars would supersede refined sugar. But there is a wide difference between the production of the raw material and the refining of the same for consumption. It will be long indeed before the sugar grower in the colonies can command the same appliances for refining as the refiner in England, and the true policy of the grower is to devote all his ability to get as large a product direct from the cane as possible, and to send the sugar here to be manufactured and refined. What the refiner and the grower alike require is the free importation of the raw material.

A far greater service, however, would be conferred on the general trade of the country by the adoption of such a policy. Even at present the trade in these articles is something considerable, £32,000,000 being the value of sugar, tea, and coffee imported into this country in 1868. Within the last twenty-five years the increase in the importation has been immense, as will be seen from the following figures:—

IMPORTS.

	Sugar, lbs.	Tea, lbs.	Coffee lbs.
1840....	505,000,000	28,000,000	70,000,000
1856....	846,000,000	86,000,000	57,000,000
1860....	1,109,000,000	89,000,000	83,000,000
1868....	1,498,000,000	155,000,000	174,000,000

The proportion of increase in the period having been—Sugar, 196 per cent., tea, 453 per cent., and coffee, 148 per cent. The home consumption at the same time increased, of sugar from 15·19 lbs. per head in 1840 to 45 lbs. per head in 1868; of tea, from 1·21 lbs per head in 1840; to 3·5 lbs. per head in 1868; though of coffee the home consumption was scarcely as great in 1868 as it was in 1840. But colonial produce imports are not only for our own use, but for that of the half of Europe. In 1868 we exported 68,000,000 lbs. of sugar, 34,000,000 lbs. of tea, and 135,000,000 lbs. of coffee, worth in all nearly £7,000,000 sterling. Such are the proportions which our trade in sugar, tea, and coffee has reached under our present system of moderate taxation, but who can say to what extent it may be increased were all such duties abolished? How can we estimate the effect of the stimulus which would be thereby conferred on our trade with the producing countries? Our exports to some of them are yet very insignificant, especially when compared with the population. To Brazil, with a population of ten millions, we exported goods to the value of £5,800,000, or in the proportion of 11/7 per head; to Madras, with a population of 24,000,000, our exports were only to the value of £1,800,000, or just 1/6 per head. We shall never get these countries to use largely our produce and manufacture, till we give the amplest freedom to the import and consumption of their productions.

One argument we cannot use. We cannot say that either sugar, tea, or coffee, are at present too dear, or that the duty imposed on them is in any way burdensome on the resources of the people, or on the working classes. Among rich and poor, in the palace and in the cottage, in towns and rural districts everywhere, sugar and tea now constitute leading articles of diet; and, it is quite evident, that every reduction of taxation in these articles has been attended with a corresponding increase of comfort and well-being among the masses of the population. Nor could any valid reason be advanced why the taxation of the labouring classes, upon whom full two thirds of such duties usually fall, should be lightened still further. If such a measure as we are now examining were practically entertained, an additional and most valid reason could exist for extending some plan of direct taxation over the wage-earning population, including large numbers who are nearly exempt altogether from taxes. The fiscal legislation of late years has been most favourable to the working classes, by enabling them to purchase the necessaries of life at prices lower than they can be had at anywhere. In former days, when protection doubled the price of any article, England was indeed a dear country to live in. Not so now. We doubt whether the articles of food and drink are as cheap in any other country. At present the working classes are paying very little for taxation. Practically excluded from the income-tax, the stamps duties, and the assessed taxes; how shall they contribute their share to the wants of the State, if we go on abolishing even the duties of sugar and tea? They pay a large amount in taxes on spirits, malt, and tobacco, but we know how unequally distributed these burdens are. Let a man be temperate and thrifty, let him be neither a drunkard nor a smoker, and he needs not pay a farthing of taxes. If by any means, therefore, the income-tax could be levied on all labourers earning 20s. a-week and upwards, the same being charged on the employer of labour with a view to its being deducted from the weekly wages, that would open the way for a much better subdivision of taxes than we can at present attempt.

But if we abolish the duties on sugar, tea, and coffee, would it not be better to abolish altogether the Customs' establishment? Could not the Inland Revenue Department collect the duties on spirits, wine, and tobacco as they do those on malt and British spirits? The amalgamation of the Customs with the Inland Revenue has long been advocated on the ground of simplicity and cheapness. At present there is a most unnecessary multiplication of offices and officers. The Customs' revenue is collected in not fewer than one hundred and fifty ports, though out of £22,000,000 of revenue, nearly £17,000,000 was collected in five ports only. What a blessing to liberate the trade of the country in so many ports and places! Even though for the protection of the revenue derived from spirits and tobacco we should require considerable appliances, I imagine that the machinery might be greatly simplified, and the expense greatly economised, were the Customs abolished, and the whole collection of duties entrusted to the Inland Revenue Department, And what a splendid example we should offer!

Let us remember that with all our professions of free trade, we derive a greater proportion of the revenue from this source than any other country, as will be seen from the following figures for the year 1866:—

Countries.	Total Revenue.	Custom Revenue.	Percentage.
	£	£	
United Kingdom	67,812,000	21,276,000	31
France	74,000,000	6,127,700	8
Belgium	6,243,000	522,000	8
Holland	6,000,000	350,000	4
Austria	33,050,000	1,243,800	4
Italy	35,000,000	3,000,000	8
Russia	397,088,000 rubles	25,203,000 rubles	6

Let us by a vigorous effort get rid of the taxes on sugar, coffee, and tea, and throw the duties on spirits, wine, and tobacco, on the Inland Revenue—for so long, at least, as they cannot be equally disposed of, and we shall have reason to appeal to other countries to follow our example in giving fuller effect than has as yet been to the grand and beneficent principles of free trade.

RESEARCHES ON THE JUICE OF THE SUGAR CANE,

AND ON THE MODIFICATIONS TO WHICH IT IS SUBJECT DURING MANUFACTURE, IN THE ISLAND OF MAURITIUS.

From the French of Dr. Icery.

(Concluded from page 146.)

PART III.

1.—MODIFICATIONS TO WHICH THE JUICE IS SUBJECT.

THE modifications undergone by the juice during its extraction are either inherent in its nature or are caused by the influence of external agents. The first are sometimes favourable, but more often adverse to the aim of the maker. The latter are always produced with the view of overcoming the recognised difficulties and of directing the manufacture in its regular course.

The limits to which I am restricted do not permit of my describing all these modifications in detail; to do this I should need at least double the space allotted to the different parts of this essay.

I will confine my remarks to the influence exercised on the saccharine of the juice by those various matters which have been the special subjects of observation in the preceding pages.

I shall not repeat what I have already said in the section on microscopical examination, of the granular matter, and of its influence in causing fermentation in juice from the best of canes in a very short time. But I must here notice the remarkable alterations caused by fermentation in the various nitrogenous substances which are natural to the juice. It is said that the sugar subjected to fermentation does not always furnish similar products, and that the kind of decomposition which results depends on the element causing fermentation. The nitrogenous substances of the juice, which I have ranged in three classes, and which I have designated by the names of granular matter, albuminous matter, and matter coagulable by alcohol, possess the property of causing fermentation in this liquid; but they do not all three act with equal energy, and only one of them usually causes fermentation properly so called, whilst the other two (albumen and the substance coagulable by alcohol and not by heat) give birth at the same time to acid products, and are much slower in acting. The granular matter is then the most active cause of fermentation, which is developed in the juice of the cane by the action of the oxygen of the air, and it also particularly contributes to the transformation of sugar into alcohol and carbonic acid.

This remark leads me to an application, of which the distillers may appreciate the utility: it is the mixture of a small quantity of scum taken from the surface of juice when boiling, with syrups difficult of fermentation; the granular matter contained in the scum will produce fermentation when ordinary means have failed.

I will not insist further on these various peculiarities at present; others have sufficiently traced the important part which this substance plays in the colonial sugar manufacture, and have shown the advantage which would result on its separation from the juice when it leaves the mill. I have indicated a process which would render great service to the sugar industry if it could be applied by some able mechanician.

The accumulation of the complex nitrogenous matter described above in the concentrated juice and in the syrup, is a fact which has not yet sufficiently excited the attention of sugar planters, but which, however, deserves to be studied with special care. It is this substance, as I have thus shown, which causes that viscous consistence and that form of fermentation called viscid, which authors have variously accounted for,

The presence of any notable quantity of so deliquescent a substance in the syrup prevents the crystallization of the sugar, in which it will, besides, produce rapid fermentation when a sufficient quantity of water is added to the liquid sugar.

It is remarkable that every agent hitherto employed in the colonial sugar manufacture has had scarcely any action on this substance, which almost entirely escapes, and accumulates more and more in the drainage, which our machinery has to work up.

The employment of a body capable of combining with and precipitating this viscid matter in the syrup would, without doubt, augment very considerably the production of sugar. The alcohol which is produced so cheaply in this colony would, I am sure, be very usefully applied to this end.

An idea of the proportion in which this matter is concentrated in the syrups may be obtained by consulting the last column of the second table, given a little further on.

It will be seen that the figures which represent it follow a rapid progression, and that they are six or seven times higher for the third syrup than for the first at 22° Baumé. The preceding column will equally show the increasing progression of the saline matters proper to the different syrups. These two substances do not always suffice to explain the resistance to the crystallization of syrups produced under certain conditions.

There is a cause of widely different mode of action—that is, the presence in the saccharine liquid under operation, of a quantity, more or less, of glucose. This glucose, or inverted sugar, is the stumbling block of the colonial industry, and the source of the principal difficulties against which the planter has to strive continually. I have clearly proved that this liquid sugar is not, as was generally supposed, produced by a modification of the cane; but that it is a part of its natural organisation, and that this kind of sugar is most abundant as the cane is furthest from maturity. I have also shown that when in the body of the ripe cane there is scarcely a trace of it, yet the top part or head of it contains a notable quantity, and that every cause productive of abnormal vegetation causes the re-appearance of this substance in the cane. We may, therefore, conclude that in the juice as generally manufactured levulose always exists, and that it is found in greater quantity when the canes producing it are less ripe, or have grown in a humid locality, or have been cut nearer to that part of the cane covered with leaves.

The presence of inverted sugar in the juice being admitted, it is easy to comprehend the first difficulty which presents itself, and the almost absolute impossibility of entirely overcoming it. How, indeed, can we avoid the prejudicial action of the lime on the levulose, which, at the boiling point, and in contact with this alkali, gives birth to those black glucose products, the presence of which so greatly alters the colour and the quality of the sugar obtained—how can we prevent this real inconvenience, and at the same time arrest the great tendency which the juice manifests to produce during ebullition a considerable quantity of glucose? The alkalinity of the liquid would, without doubt, put a limit to this rapid change; but this alkalinity would itself at the same time have more fatal consequences than the evil it was sought to remedy.

Lime, of which the utility is incontestable, but the importance of which we are too disposed to over-estimate, cannot then be employed in excess without causing one of the most injurious modifications to which juice is subject, its immediate effect being to give a brown colour to tho syrup, and its ultimate effect to make the sugar produced from it dark and clammy.

Without going further into the action of lime on juice containing a certain quantity of levulose, which is too well known to need remark here, I may say that the difficulties experienced in the manufacture of sugar in humid localities, and the inferior qualities produced in these places, until the introduction of the vacuum pan, may be chiefly, if not entirely, attributed to the large proportion of liquid sugar which canes grown on these damp places naturally contain, aggravated by their being cut in full vegetation.

When the juice contains only traces of this substance, as in canes grown in dry and airy places, it is very easy to manufacture, but even then an excess of lime cannot be used without very materially depreciating the quality of the sugar.

The use of lime, in the process of manufacture which prevails at present, is limited to gradually neutralizing the acidity of the juice.

Employed in too small proportion, this alkali is not a sufficient preventive of the glucose transformation of crystallizable sugar, under the influence of the nitrogenous matter which is not coagulable by heat, and the syrups then become strongly charged with levulose. Used in such a manner as to keep up in the liquid a slightly alkaline reaction, the sugar in the juice rarely becomes inverted, but it will acquire a shade which will place it in a lower rank in the market; and as the most desired quality and shade of colour can only be obtained from juice kept slightly acid, the attention of the manufacturer should be directed to realise these grades of quality with the smallest glucose transformations possible—that is to say, not to exceed for any given type the requisite degree of acidity.

But it is immediately after the separation of the scum that the acidity of the juice should be most carefully attended to, because the temperature of the juice is then increased rapidly, and the inversion of the crystallizable sugars is only too easy.

To estimate the different quantities of inverted sugar which are produced both from juice in its natural state, and in consequence of the greater or less acidity of the liquid during manufacture, I have made several analyses, the results of which will be found in the following tables, which show respecting the modifications belonging to inverted sugar :—

1st. That of two juices, one from canes fully grown though not quite ripe, the other from canes fully mature, both manufactured under the same conditions, that the glucose transformation of the latter is very feeble, but of the former very active, and in such proportion that the second syrup produced from the unripe canes contains nearly equal parts of prismatic sugar and levulose, so that its further manipulation is useless, whilst the third syrup from the ripe canes contained only 27 per cent. of levulose, and was consequently fit for further boiling.—*See Tables Nos.* 2 *and* 3.

2nd. That the acidity kept up in the juice with the aim of obtaining a certain quality of sugar, is often carried beyond the condition necessary to realise this quality, and becomes thus the cause of appreciable loss, as the syrups cannot be reboiled with profit when the quantity of levulose they contain is above 37 per cent. of the whole saccharine matter.—*See Table No.* 1.

Being obliged to restrain this essay with certain limits, I am not able to pursue further the consideration of the transformation of crystallizable sugar; what I have already said on this important question, and the results given in the following tables, are sufficient to give to those who are strangers to the sugar industry some idea of the considerable part which is played in the colonial sugar manufacture by levulose or uncrystallizable sugar, of which tho canes operated on, always contain a quantity more or less great.

II.—Yield of Sugar from Different Juices.

The yield of sugar obtained by means of the processes used in our colonial manufacture is necessarily sensibly much influenced by this glucose transformation, and it may be generally asserted that all tho causes which tend to develope it, doubly act in diminishing the quantity of saccharine extracted from the juice, because they not only cause the loss by the change of crystallizable sugar into uncrystallizable, but they introduce into, and accumulate in the syrups a substance, the presence of which becomes moro and more an obstacle to the separation of the sugar which still remains in them in large proportion.

The barrel of juice (54 gals.) weighs 583lbs. at least, to 598lbs. at the most—in the first case containing about 82lbs., and in the next about 133lbs. of sugar. On the average this quantity of sugar may amount to 104lbs. per barrel of juice such as is commonly operated on. All things being equal, the proportion of sugar extracted from a barrel of cane juice depends not only on the relative richness of this liquid, but also on the different circumstances under which the manufacture takes place. And as these circumstances are very variable, it is difficult to represent in figures the general average return of the sugar industry in this colony. I may however, give in this respect some indications which will give an idea of the yield of a manufactory placed in the most favourable conditions. For which purpose I cannot do better than transcribe the records with which I have been favoured by the Hon. C. Wiché, the proprietor of one of the best, and best-conducted establishments in this country.—*See Table No.* 4.

TABLE No. 1,

SHOWING THE QUANTITIES OF CRYSTALLIZABLE AND INVERTED SUGAR, AND OF SALINE MATTERS CONTAINED IN SYRUP AT 77° FAHT., AND 41° BAUME, THE QUALITY OF THE SUGAR MADE BEING NEARLY ALIKE.

	Names of Estates.	Reaction of Syrup.	Percentage of Uncrystallizable Sugar contained in the Juice from which the Syrup analysed was obtained.	Total of Sugar obtained per cent. of Syrup.	Crystallizable Sugar per cent. of Syrup.	Inverted Sugar per cent. of Syrup.	Proportion of Crystallizable and Inverted Sugar per cent. of the whole Quantity of Sugar.		Saline Matters per cent. of Syrup.
							Crystallizable.	Uncrystallizable.	
1st Syrup.	La Gaieté....	Nearly neutral	·3	83·0	75·2	7·8	91	9	2·7
	Labourdonnais	Acid........	·4	81·3	59·7	21·6	73	27	4·0
	Bel-Etang ..	Nearly neutral	1·2	71·8	54·4	17·4	76	24	..
	Sebastopol ..	Neutral	·9	74·1	59·2	14·9	80	20	..
	Moka	Nearly neutral	·8	69·9	52·5	17·4	75	25	..
2nd Syrup.	La Gaieté....	Nearly neutral	..	69·2	57·6	11·6	83	17	4·6
	Labourdonnais	Acid........	..	74·1	49·9	24·2	67	33	5·0
	Bel-Etang ..	Acid........	..	50·6	29·6	21·0	58	42	..
3rd Syrup.	La Gaieté....	Neutral	..	62·9	48·3	14·0	77	23	6·0

TABLE No. 2.

Determination of the Relative Quantities of Inverted Sugar, and of Saline and Albuminous Substances found in Juice and in Syrups obtained from it, Examined at the same Temperature and Density.

Canes fully developed and RIPE. Juice manufactured with a neutral reaction after the separation of the scum.	Temperature.	Density.	Reaction.	Absolute quantity of Sugar per cent.	Crystallizable Sugar per cent.	Uncrystallizable Sugar per cent.	Proportion of Crystallizable and Inverted Sugar in the total quantity of Sugar.		Percentage of Ash found in the same quantity of liquid.	Percentage of Albuminous substances found in the same quantity of liquid.
							Crystallizable Sugar per cent.	Inverted Sugar per cent.		
Juice from canes as above	77° Fahr.	1071	Acid.	16·7	16·4	·3	98	2	·32	·39
Syrup produced from the above juice examined at the moment when sent from the battery to the vac. pan at 22° B.	....	....	Neutral.	16·5	15·8	·7	95	5	·25	·32
1st syrup obtained from the preceding after extraction of the 1st sugar	....	....	Neutral.	14·7	12·2	1·5	83	17	·83	·63
2nd syrup obtained from the preceding after extraction of the 2nd sugar	....	....	Neutral.	12·5	9·8	2·7	78	22	1·08	1·09
3rd syrup from the preceding after extraction of the 3rd sugar	....	....	Neutral.	11·4	8·3	3·1	73	27	1·64	2·13

TABLE No. 3.

DETERMINATION OF THE RELATIVE QUANTITIES OF INVERTED SUGAR, AND OF SALINE AND ALBUMINOUS MATTERS FOUND IN THE JUICE AND IN THE DIFFERENT SYRUPS OBTAINED FROM IT, EXAMINED AT THE SAME TEMPERATURE AND DENSITY.

Canes fully grown, but NOT FULLY RIPE; the juice less rich; manufactured with a nearly neutral reaction after the separation of the scum.	Temperature.	Density.	Reaction.	Actual quantity of Sugar. Per Cent.	Crystallizable Sugar. Per Cent.	Uncrystallizable Sugar. Per Cent.	Proportion of Crystallizable and Inverted Sugar in the total quantity of Sugar.		Percentage of Ash from the same quantity of liquid.	Percentage of Albuminous substances.
							Crystallizable Sugar per cent.	Inverted Sugar per cent.		
Juice from the above canes	77°Fahr.	1071	Acid.	14·4	12·9	1·5	87	13	·22	·47
Syrup produced from the above juice, and examined at the moment when sent from the battery to the vac. pan at 22° Baumé	....	....	Nearly Neutral.	....	....	....	....	....	....	....
1st syrup obtained from the preceding after extraction of the 1st sugar	....	....	Nearly Neutral.	12·5	9·6	2·9	76	24	·87	·71
2nd syrup obtained from the preceding after extraction of the 2nd sugar	....	....	Neutral.	9·9	5·7	4·2	57	43	1·1	1·32
3rd syrup obtained from the preceding after extraction of the 3rd sugar	....	....	....	....	....	....	....	....	....	....

TABLE No. 4.

Crop.	Average Quantity of Sugar per Barrel of Juice.	Nett Produce of Crop.	Weight of Canos per "Arpent"*	Average of Yield per Arpent.	Quantity of Sugar of 2nd and 3rd Boilings, per Cent of 1st Boiling.			Average of Barrels of Molasses for each 100 milliers of Sugar.
					Second Boiling or Sugar of 1st Syrup.	Third Boiling or Sugar of 2nd Syrup.	Total.	
	liv.	liv.	Tons.	liv.	liv.	liv.		
1854-55	80	3,008,137						
1855-56	76½	2,287,259						
1856-57	77¼	3,381,800						
1857-58	73	2,790,000						
1858-59	72	2,891,776						
1859-60	70	1,902,336						
1860-61	70½	3,422,584	28·5	5,415				
1861-62	75½	2,047,940	15·8	3,250	21	6⅓	27⅓	
1862-63	75⅓	3,374,761	23	4,712	22	6½	28½	28½ barrels
1863-64	75	2,662,924	19	3,848	25	8	33	33⅔ ,,

* The Arpent d'Ordonnance = 1·262 acre; the Paris Arpent = ·84 acre; the common Arpent = 1·044. Which of theso is meant in this Table is uncertain.—*Ed. S. C.*

The results which I have obtained at La Gaieté during the last two years being very little different from those given in this table, I abstain from producing them here.

THE SUGAR INDUSTRY OF JAVA:

BEING A SERIES OF PAPERS READ BEFORE THE INDIAN SOCIETY OF HOLLAND, DURING THE SESSION OF 1868-9.

BY J. MILLARD, ESQ.

Translated from the Dutch, by permission of the Author.

DIVISIONS OF SUBJECT.

PART I.—The sugar industry of Java considered in relation to that of other colonies or possessions, and to that of the beet root.

PART II.—The actual state of the sugar industry of Java: its relation to

The Government;

The Planter.

The Native population, embracing the connection of capital, labour, and land with each other.

PART III.—The means by which a durable flourishing sugar industry may be established in Java.

General meeting held on the 10th November, 1868.

Chairman: Dr. Weir J. van Sweeten.

To elucidate the first main point:

The sugar industry of Java, considered in its relation to that of other colonies or possessions, and to that of the beet-root.

The following paper, from Mr. MILLARD, was read:—

The subject we intend to treat is ample, for, in many respects, it stands in very close connection with the most important colonial subjects of the day. There is, perhaps, no kind of industry that has engrossed the attention of men of science more than that of sugar in all its branches. Chemistry, mechanics, and agriculture have united their efforts to promote its development, and the field of inquiry is still sufficiently wide to afford employment for the energy of theorists, as well as of practical men. The names of those meritorious men, who have directed their studies to the various sugar producing plants, are too well known for enumeration of them to be necessary here. The problem I shall now endeavour to solve is one mainly of an industrial and economic character, and chiefly concerns the sugar industry of Java.

In illustrating the three principal points, my plan will be to attempt to establish the following positions:—

I.—The sugar industry of Java can hold its own in competition with that of other colonies and of Europe.

II.—In the actual state of the sugar industry, the interest on capital, the profits of the manufacturer, and the share of the husbandman in the produce of the land are in unjust proportion to one another.

III.—The labour bestowed on the cultivation of the sugar cane, with an average crop, is sufficiently, sometimes amply rewarded, but his rightful share is withheld from the native landholder, inconsistently with his right of possession, and in opposition to the original plan of the founder of the system of cultivation.

IV.—In the present state of things, free labour in the sugar industry has, from local circumstances, many, and often insurmountable obstacles to contend with.

V.—Free labour, or the free cultivation of sugar does not exist; in the present social state, it can only exist under very exceptional circumstances, by no means as a social element; for want of individual possession of land.

VI.—Though by a special order, the present contractors may even obtain an indemnification to which no right is given them by contract, but to which a fair claim is acknowledged, nevertheless, a durable flourishing sugar industry cannot be established without the individual possession of land.

VII.—The sugar industry of Java with free possession of, or property in land, obtained with the consent of the population, or granted to it by the Government, will be able to yield to capital the necessary guarantees, to labour a fitting reward, to the landholder an equitable ground rent, and to the Government, as imposer of taxes, a fair and proportionate profit.

The choice of this subject for our deliberations may be remarked as a proof of interest; nevertheless, I consider it not superfluous to inquire whether the sugar industry of Java really deserves that interest. The opinion has, indeed, once been put forward, that, left alone to its own course, it could not be maintained, and it would have to succumb to the more and more progressing beet-root sugar; not long ago, even one of our most influential journals of the Netherlands proposed the abandonment of that industry in Java for the culture of something else.

Truly, if it is to be considered but as a parasite, if in the long run it cannot contribute to the welfare of the people, if the capital employed upon it is artificially drawn away from richer sources, then, with such conviction, the question would hardly deserve our attention, and every new regulation would be vain.

The first point leads us to inquire what vital strength the sugar industry possesses in its present position, what place it now fills or can fill in comparison with that of similar branches of industry in Europe or in other colonies.

Let us, in the first place, cast a glance at the manufacture of beet-root sugar, the rival that is considered the most formidable for Java.

The beet-root sugar manufacture, called by the famous Thiers *la jeune géant*, for which the French language has even coined a new term, "*la sucrerie betteravière*," has a remarkable history, but the limits within which I have to confine myself do not allow me to be diffuse on the subject. After much opposition, and considerable losses, it gradually increased in strength, and in France, as well as in Germany, has taken a high place. Having its origin in the continental system of Napoleon I., who encouraged it with premiums; after the conclusion of the peace of Europe, it languished, as a consequence of which foreign sugars, chiefly from the English colonies, found markets in France.

Although I must refrain from historical details, allow me to point to one important epoch that has exercised a powerful influence on the sugar industry in general.

The sugar growers of the French colonies, alarmed by the large imports of foreign sugar into France, complained loudly, and insisted that the Government should restore protection, which was done by levying a high rate of duty on foreign sugars, consequently the prices of sugar rose considerably, of which circumstance the beet-root industry took advantage.

In 1825, a hundred manufactories of beet-root sugar were again called into existence, this development of strength soon acted as a stimulus to Germany also, to devote itself to that industry, where, as in France, it was at first encouraged by freedom from excise.

We may venture to advance the supposition, that but for the protection invoked by the colonial growers, the production of sugar from the cane would have kept its ground undisputed, and thus they furnished the weapons from which their own interests have suffered.

In that second period the beet-root sugar industry received powerful help from chemistry and mechanics. From the various statistical tables of the produce we obtain these results:—

In France the yield of beet sugar had increased from 4,380 tons in 1829 to 274,000 in 1866.

In Germany from about 3,000 tons in 1828 to full 200,000 in 1867.

In Austria from full 1,500 tons in 1839 to 67,500 in 1867.

In Belgium from 3,000 tons in 1841 to full 39,000 in 1867.

In France the consumption is for the greatest part, and in the Zollverein and Austria it is wholly, supplied by the sugar made from the beet-root.

To the refuse of the beet-root in the manufacture of sugar, agriculture is indebted for an excellent food for cattle, and a rich manure. Many assert as the result of experience that the cultivation of the beet-root is not injurious to other crops, and that on the contrary many experiments prove that after deep working and constant clearing of the soil on which the beet-root has been grown, it yields rich returns in subsequent crops of corn, &c. This opinion, however, is not universal. Some call the culture a curse to the land, and I remember that, among others, Professor Baumhauer, at one of the agricultural congresses, strongly protested against the extension of this branch of agriculture in the Netherlands.

Be it as it may, the cleverest inventions were applied to the manufacture, double pains were bestowed on the culture, and the establishments which I have visited bear witness to the way in which science and art united have been able at the present time to obtain from 6 to 8 per cent. of sugar from a plant, which, in the time of Markgraf, who first pointed out its sugar bearing qualities, and even of Achard, to whom, in the beginning of this century, Europe was indebted for its use, formerly yielded only 1 per cent., or, at most, 2 per cent. of its saccharine richness.

To its efforts and progress the colonial sugar industry owes much, and if it is true that the industry of Java follows but slowly in its track, it is to be attributed chiefly to the fact that the means are withheld by which its progress might be promoted. A manufacturer who compares the progress of the sugar industry of Europe with that of Java will be fully convinced how large a field for improvement lies open to the latter.

The agriculture in Java is not less behind-hand. Although the beet-root is indeed, a plant which exhausts the land, its advocates assert that science, by means of manuring and draining, has not only found a remedy but has even improved the soil. The culture of the beet-root, and the application of its waste as food for cattle and as manure for the fields, have been the constant study of agricultural science.

Besides, the beet-root sugar industry has provided plenty of work and good wages for hands, which, in winter, would otherwise often seek them in vain. In France it is calculated that 6,000,000 guilders (£500,000) are paid to 40,000 labourers in wages.

The value of the manufactories in France is estimated at 40,000,000 guilders (£3,600,000), and how valuable to all other branches of trade an industry is which in France sends more than 4,000,000 picols (240,000 tons), and in the Zollverein 3,000,000 picols (180,000 tons), to market, needs no extensive proof.

It is, then, no longer colonial sugar alone, but beet-root sugar also, that rules the markets, and gives them their tone.

Thus the competition of the beet is powerful, and it is not without danger to the cane sugar industry. In America, also, the idea has been formed of introducing that industry, and the Government promotes its establishment by all the means in its power. But yet it has not been able to retard the progress of the cane sugar production in the colonies.

"If," says a respected expert and warm advocate of the beet-root sugar industry, "a piece of sugar cane and the root of a beet be subjected to the most simple chemical examination, it will be found that the juice extracted from the former contains 18 to 20 per cent. of saccharine matter, whereas that extracted from the latter contains but from 10 to 12 per cent; that the juice of the tropical plant is, as it were, composed only of water and sugar, contains but a few parts of nitrogenous or mineral substances, but, on the contrary, the beet-root juice contains a great many, chiefly soda and potash salts. The albuminous and nitrogenous constituents of the cane and of the beet-root are in the proportion of 1 to 3. On the other hand, the beet-root has only a thin covering, whereas the bark of the cane occasions much difficulty in the extraction."

But in the smell and the taste of those plants yielding sugar there is a peculiar difference. "The one is as superior to the other in this respect as the perfume of the pine-apple of the Antilles is to that of the cider apple of the Normandy orchards."

The saccharine richness of the beet-root and that of the sugar cane have, during many years been made a subject of careful research by a number of scientific men. Not to go too far into details, I may refer to the works of Emhof, Herman, Chapsal, Pelouze, Péligot, Dupuy, Dutrone, Casaseca, and others, on that subject. The quantity of water in the beet is fixed at 83 per cent.; that in the sugar cane at 72 per cent.

That chemical and physical causes and the condition of the soil exert more or less influence on the saccharine richness, needs no demonstration. There are instances in which, in Java, the juice shows 12° Baumé, or almost 22 per cent.; but, also, in which the Silesian beet-root contains 16 per cent. of sugar. With careful experiments—which, however, must be considered as exceptions—beet-roots have been grown containing a saccharine richness of 21 per cent.

Defective apparatus causes the pressing of the cane to be still imperfect, the treatment of the juice is far from what it ought to be, and the formation of uncrystallizable sugar is still considerable. In the manufacture of beet-root sugar too, much is still constantly lost. The syrups of the beet-root contain 50 per cent. of their own weight in crystallizable sugar, and the pulp is still impregnated with it. Means have not yet been found to secure more than 80, at the highest 85, per cent. of the fluid that the beet-root contains.

The sugar cane in Java, as elsewhere, is not always equally rich. Several trials give an average quantity of 18 per cent. in the present state of the culture which, however, is susceptible of great improvement.

The researches of Corenwinder teach how widely the yields of beet-root differ. The black soils of Russia yield 8 or 9 per cent. of sugar. In Germany the saccharine richness is much less; and there are sorts of mangold wurzel which yield but 2 or 3 per cent.

In France and Germany the yield varies from 6 to 8 per cent.; in the Netherlands it seldom falls below that amount. In an ordinary year in France 5½ to 6 per cent. is reckoned on; but in the present season, from the unfavourable state of the weather, 5 per cent. at the highest may be expected.

The beet-root is very susceptible of damp, and liable easily to turn sour. Keeping it, then, after the roots have been removed from the fields, diminishes its saccharine richness. But the sugar cane, also, must be operated on soon after it has been cut, because acidity quickly takes place, and by it uncrystallizable sugar is formed.

Means to prevent injury to the beet-root have been devised in vain. In Java the disadvantages of too long stacking the sugar cane have frequently been felt; that, however, is chiefly caused by interruptions in the work.

The expression of the beet-root, with the now improved machinery, may be estimated as amounting to 75 to 80 per cent. In proportion to the power of the mills in Java, 65 to 75 per cent. —probably 70 per cent., on an average—may be reckoned on. In that respect Java possesses advantages above many other colonies, where as yet, only 55 to 60 per cent. is obtained. Hering, the author on the Sugar Culture in Surinam, mentions 55 per cent. as a particularly good result, whereas 45 per cent. is the ordinary yield there. Dupuy, in 35 experiments, obtained 68½ per cent. as maximum, and 54 per cent. as minimum; average, 59½ per cent.

Nevertheless, in this respect, great improvement is to be seen in other colonies that have imported improved machinery. Among others, in Mauritius, just as in Java, 70 per cent. of juice is obtained.

Supposing we fix the saccharine richness of the beet-root at 10 per cent., that of the sugar cane at 18 per cent., we should thence determine at once on the superiority of the latter; but the reality is less than that. From the returns appearing in the Java newspapers concerning the yields of the cane—if, at least, sufficient confidence may be placed in those statements—it appears that the average saccharine richness has been 8·5° Baumé; the quantity of juice, 24,769 litres per bouw (about 3,100 gallons per acre); the production, 45 picols per bouw (about 1½ tons per acre); the absolute weight of sugar in the juice, 64 per cent., with 2,151 bundles of cane per bouw.

These figures may lead to important observations. The statistics of the manufacture of sugar in France are still far from perfect. We are left in the dark as to the quantity of beet-root cultivated, the juice that is obtained from it, and the saccharine richness of the whole. We know only that last year 274,000 tons of sugar were produced.

The yield of the beet-root, as that of the sugar cane, depends on the nature of the soil, and chiefly on the manner in which it is worked. The constant planting of the beet-root on the same soil has made its ill effects felt, and expensive sorts of manure have become indispensable; for the plant draws an astonishingly large quantity of mineral substances from the land, so that we may calculate that for the 250,000 acres planted with the beet-root in France, 10,000 tons of mineral substances must be restored to the soil, and the manuring is necessary even where recourse is had to the rotation of crops. Where, formerly, one hectare (nearly 2½ acres) yielded 50 to 60 tons of beets, at present not more than 30 or 40 tons can be reckoned on. In several districts of France the beet-root harvest has fallen 8 or 10 tons of beets per acre.

Moreover, the beet-root has many mischievous vermin to contend with, which feed upon it, and to destroy which the experts have hitherto tried in vain. By the removal of so many constituents from the ground the existence of so many sickly elements in the soil may be accounted for.

Calculating as an average in France of 35,000 kilos. per hectare, with a yield of 6 per cent. of sugar, we get an average production of 2,100 kilos. per hectare, 16¾ cwt. per acre.

The sugar cane also has an exhausting effect on the soil. Chemical researches teach us that 1,000 lbs. of cane yield 3 lbs., and 1,000 lbs. of leaves 20 to 30 lbs. of mineral substances; so that reckoning a bouw of cane on an average at 40,000 lbs. of cane and 16,000 lbs. fresh leaves, the 70,000 acres in Java, planted with sugar cane, draw 24,000,000 lbs. of mineral substances from the land, which, under the present system of management, are lost.

Germany supplies us with ample reports on the culture and manufacture of beet-root sugar, from which I borrow the following:

In 1863-64, in the Zollverein, 300,000 morgen (185,000 acres), and 1864-1865, 325,000 morgen (200,000 acres) were planted with beet-root.

According to official returns in 1865-1866, there were 2,172,000 tons of beet-roots obtained, which yielded 185,000 tons of sugar, therefore full 8 per cent. of the weight of the beet-roots, or 11·4 centenaars per morgen (18 cwts. per acre).

In very favourable years the production rises to 8½ per cent. of common sugar (No. 12 to 14), but of refined the yield is scarcely 7 per cent.

There were 253 (in 1850 only 184) manufactories at work, supplying on an average about 10,000 picols (590 tons) each.

The average quantity used by each manufactory is calculated.

In Wurtemburg, at 208,000 centenaars (10,400 tons) of beet-roots.
In Brunswick, ,, 173,000 ,, (8,150 tons) ,,
In Prussia, ,, 150,000 ,, (7,500 tons) ,,
In Thuringia, ,, 123,600 ,, (6,150 tons) ,,
In Bavaria, ,, 70,000 ,, (3,525 tons) ,,

The largest sugar manufactory is at Waghausel (between Mannheim and Carlsrühe), which seldom works up less than one million centenaars a year.

In Austria, in 1864-1865, 69,869 jock (about 102,000 acres) were planted, which on an average yielded 28,450 kilos. of beet-roots per hectare, or, reckoned at the average yield of 7 per cent. of sugar, in all 1,640,000 centenaars (82,000 tons) of sugar, therefore 1991½ kilos. per hectare (about 15¾ cwts. per acre) for 144 manufactories, on an average about 500 tons each.

The statistical returns of Russia are very uncertain, since the government only assumes a yield of 3 per cent. for the Excise duty, whereas competent judges fix it at not less than 6 per cent; even for 1864 the official paper returns 8·16 per cent., in all, 55,200,000 kilos. (54,000 tons) produced by 283 manufactories. In truth, however, the production is fixed at double, whereas the surface of the land cultivated is unknown.

From these returns, carefully drawn from official sources, it thus appears that the productive power of the sugar plantations of Java surpasses more than twice, frequently three or four times, that of the beet-root grounds of the principal sugar producing countries of Europe. Even if the culture of beet-root sugar assume a proportion till now unattained, the utmost limit will be 45 picols per bouw (about 30 cwts. per acre).

In other respects, the beet-root sugar cannot compete with the colonial, particularly the Java. Delicate perception is sensible of a peculiar, less pleasant, and somewhat faint taste in the beet sugar; and although the remark of the celebrated Chapsal is true, that when the beet-root sugar has been purified by refining, it is difficult to recognise the difference from cane sugar, neither can the assertion of the chemist Professor Gerardin, be denied, that the raw cane sugar has a sweeter, honeylike taste, the beet-root sugar a more or less sharp after taste, either an alkaline or an acid taste, and is altogether without the honey flavour. The refiner, at least in this country (Holland), always prefers the cane sugar. It is asserted that in working up, beet sugar loses 12 per cent. more than the cane sugar. On the other hand it entices the buyer, as being specifically lighter, it presents a larger volume for a given weight than the cane sugar.

It has also been observed, that in fermentation of the sugars, that of the cane gives off a fume of rum, and that of the beet-root one of tainted blood.

Since the government of the Netherlands has experienced the disadvantage of the lower sorts of sugar, and encouraged great improvements by means of the contracts, the Java sugar has surpassed all the other sugars in quality, which was frankly acknowledged by the best judges in England, on the occasion of an inquiry into the sugar duties, instituted by Parliament in 1864; and, therefore, it seems not uninteresting to subjoin a report* of the usual sorts of the sugars from different colonies:—

			SCALE.
Manilla		No.	4 @ .. 9
Bengal and Benares		,,	4 — .. 16
The White No. very weak sugar—			
Brazil	brown	,,	5 — .. 10
	white	,,	12 — .. 17
	average	,,	12 — .. 13
Cuba		,,	5 — .. 22
	average	,,	13 — ..
Mauritius		,,	8 — .. 14
	average	,,	11 — ..
Unclayed, Muscovado sugar.	Martinique and Guadaloupe. English West India, (very different, but classed together)	,,	10 — .. 12
	Louisiana, as far as known.	,,	8 — .. 12

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* Report of Mr. J. Rueb, in his pamphlet on the treaty for regulating the duties on sugar.

The Java Sugars, which the Dutch East India Company sell by auction, reach the Nos. 15 to 20. Generally No. 13, at the highest No. 14, is the average of the sugars extracted from the beet root.

Nevertheless, the so-called international sugar convention, of which we shall presently make mention in a few words, at present exerts a fatal influence on that quality, and threatens to undermine the reputation of the Java sugars.

Let us now take a hasty survey of the production of sugar in other colonies.

In this, Cuba plays the principal part. From 1826 till 1830 this island exported but 81,000,000 kilos. (80,000 tons); in 1854, already 552,000,000 kilos. (above 500,000 tons); and now the production is estimated at 10,000,000 picols (600,000 tons).

In Guadaloupe and Martinique a few manufacturers have, by means of improved machinery and a better manner of working, succeeded in getting double the former quantity of sugar from the cane, viz., 10 per cent. instead of 5 per cent. Railways have been laid down to facilitate the conveyance, and the prospect has been afforded of the manufacturers soon being able to export sugars which may be immediately taken to market, without needing to be refined. At present, a great part of the sugar of Réunion known as "*sucre d'usine*" surpasses all the other sorts of sugar from the French colonies, and there are establishments which export from one to two million kilogrammes yearly.

In 1763, the writer Jules Deval, in his work "Les Colonies et la Politique Coloniale de la France," drew attention to the backward state of the manufacture of sugar in the French antilles, both on account of the imperfect means of preparation and the neglected culture. The warning was listened to, and now the good consequences might be seen if the colony had not suffered from the great want of workpeople, the engagement of whom from British India is made extremely difficult, and will probably cease altogether.

(To be continued.)

ON THE DETERMINATION OF CRYSTALLIZED SUGAR.

By James Bell, Esq.

(*From the Chemical News.*)

Two processes for the determination of crystallized sugar have been proposed, one by M. Dumas, and the other by M. Payen. Both methods are based on the insolubility of crystallized sugar in alcohol saturated with refined white sugar, while inverted and uncrystallized sugars are supposed to be soluble therein. These two processes, while differing in many important particulars, are essentially the same in the method followed in liberating the crystallized sugar, which consists in mechanically washing out, by simple agitation, the inverted and uncrystallized portion. This method of operation may be adapted for the analysis of superior qualities of sugar, but it is not applicable to low descriptions, such as "jaggery" and low "concrete," or to mixtures of sugar and treacle. In the analysis of "jaggery" and "concrete," &c., simple agitation in the test liquor is not sufficient to dissolve out and remove the whole of the inverted and uncrystallized sugars, and liberate the crystallized portion. When the proportion of inverted and uncrystallised sugars present is tolerably large, the sample possesses a considerable degree of tenacity, and it is not practicable, by simple agitation, to reduce it into that minutely divided state which is essential to admit of the solvent power of the test liquor being brought into full action; and in practice, in order to effect a complete disintegration of the sugar, it is necessary to operate in a mortar, and to gently rub the sample in the test liquor with a pestle.

The alcohol employed in both Dumas' and Payen's processes is of a strength of 85°, or a little under 50 over proof strength, and, prior to saturation, there is added to the alcohol 5 per cent. of acetic acid, for the purpose of decomposing and dissolving any salts of lime, &c., that may be present. Before submitting the sample to the action of the test liquor, M. Payen removes the "2 or 3 per cent."

of moisture it contains by "absolute alcohol." It is obvious that this could not be done with samples containing large percentages of treacle, such as those to which the process hereafter described is applicable, as the "absolute alcohol" could not abstract the water from them, on account of their viscidity, and even if it were possible for it to do so, the reduction in strength would be so considerable that the alcohol would have a very appreciable solvent action.

The strength of the alcohol has a very important influence upon the accuracy of the result, and while it is desirable to keep the strength as high as possible, that the alcohol may be readily saturated with a small quantity of crystallized sugar, and that a slight reduction in strength will not materially increase its solvent power, it is, on the other hand, essential that the alcohol should be of such a strength that the proportion of the test liquor used for washing the sample will be sufficient to dissolve the whole of the inverted and uncrystallized sugars present.

Alcohol, at the higher strengths, has a very limited solvent power for sugar; but its power for dissolving the sugar increases in a greater ratio than its reduction in strength. For example, at a temperature of 60° Fahrenheit, 100 grains of alcohol by measure of the respective strengths of 62·6, 55·7, and 49·6 over proof dissolve 0·52, 1·34, and 2·94 grains of crystallised sugar respectively. It will thus be seen that, from 62·6 to 55·7, over proof, a reduction in strength of 6·9°, the solvent power of the alcohol is increased by only 0·82 of a grain, or 0·12 of a grain for each degree of reduction in strength, while from 55·7 to 49·6 over proof, a reduction in strength of 6·1°, the solvent alcohol is increased 1·60 grains, or 0·26 of a grain for each degree of reduction, being more than double the ratio of the increase from 62·6 to 55·7 over proof. In like manner, the solvent power of alcohol for inverted sugar increases with its reduction in strength, but not in an increasing ratio, as in the case of crystallized sugar; on the contrary, the ratio of increase appears to be a diminishing one.

It is necessary to bear these facts in mind in selecting alcohol of the most suitable strength for preparing the test liquor. If the alcohol be of a very high strength, the result will show a higher percentage of crystallized sugar than is known to be present; but, on the other hand, if the alcohol used be of a very low strength, there will not only be considerable difficulty in fully saturating it with cane sugar, but the result will be a much less proportion of crystallized sugar than there should be.

This may be illustrated by the following results obtained from experiments made upon the same mixture of refined sugar and treacle, with test liquors prepared from alcohol at each of the strengths specified:—

				Percentage of Crystallized Sugar.
1.	Alcohol of	40	over proof gave	49·20
2.	,,	56	,,	,, 54·49
3.	,,	63	,,	,, 64·70

The result obtained in No. 2, by alcohol of 56 over proof strength, is within a few tenths of the quantity of crystallized sugar known to be present. The large excess in No. 3 is doubtless due to the very limited solubility of inverted and uncrystallized sugars in alcohol of that strength, and the consequent difficulty of dissolving the whole of these sugars in a given number of washings, and thus liberating the crystallized portion. In No. 1 there is a considerable deficiency, which is probably due to the water in the sample having increased the solvent power of the alcohol at that strength in a greater ratio than in the other cases at the higher strengths. The additional quantity of crystallized sugar, however, which the reduced test liquor dissolves is not, as a rule, in proportion to the reduction which the quantity of moisture in the sugar would make in the strength of the alcohol, a circumstance which is due to the fact that the time the test liquor and the sugar are in contact is too short to allow the former to become completely saturated.

After making a variety of experiments, it soon became obvious that the most suitable strength of alcohol to be used for preparing the test liquor lay between 50 and 56 over proof; but that it could not be absolutely affirmed that alcohol of any particular strength was applicable to the analysis of all descriptions of sugar, ranging from the finer qualities down to molasses.

To ascertain the relative value of alcohol at the strengths of 56 and 50 over proof for preparing the test liquor a mixture was made, consisting of 60 parts of purified white sugar and 40 parts of treacle, and experiments were made on the mixture with saturated alcohol at each of the strengths named, with the following results :—

	Percentage of Crystallized Sugar.
Alcohol of 56 over proof gave	59·12
" 50 " "	57·72

Thus, with alcohol of a strength of 56 over proof, there was a loss of 0·88 of crystallized sugar; but with the alcohol of 50 over proof, the loss amounted to 2·28 grains, or nearly 2½ per cent. more than in the case of the alcohol of the higher strength. The test in this case was very rigid, and upon this ground, as well as as from a slight loss which must inevitably occur in manipulation, the loss of the 0·88 of crystallized sugar with the alcohol of 56 over proof strength may be accounted for. With refined sugar it is not only difficult to obtain an intimate and uniform mixture of the crushed crystals and treacle, but the crystals remain exposed, as it were, to the immediate action of the first portion of the test liquor, which acquires increased solvent power from the additional moisture which it takes up from the sugar. The sample of treacle employed in the preparation of the mixture was found to contain 3·35 per cent. of salts and other impurities insoluble in the test liquors; and, in calculating the results, an allowance was made for the proportion of insoluble matter contained in the quantity of treacle used in the experiments.

To determine whether a test liquor prepared from alcohol of a strength of 56 over proof would give uniform results with mixtures of crystallized and inverted sugars in all proportions, mixtures were made of treacle and raw sugar, varying from 10 to 90 per cent. of each, and the several mixtures were submitted to careful analysis, and the same conditions observed in every instance. Three analyses were made of each mixture, and also of the raw sugar, and a mean of the results taken.

The raw sugar used was of medium quality, and gave 84·69 per cent. of crystallized sugar. The treacle employed was the same as that used in the experiments referred to above, and in each instance the proper allowance was made for the proportion of salts and other impurities insoluble in the test liquor. The mean results of the analyses made of the respective mixtures were as follows :—

	Percentage of Crystallized Sugar by calculation.	Percentage of Crystallized Sugar by experiment.	Loss.
90 parts of sugar and 10 of treacle	76·22	75·80	0·42
80 ,, ,, 20 ,,	67·75	67·84	Gain. 0·09
70 ,, ,, 30 ,,	59·28	59·71	0·43
60 ,, ,, 40 ,,	50·81	51·44	0·63
50 ,, ,, 50 ,,	42·34	43·65	1·31
40 ,, ,, 60 ,,	33·87	36·01	2·14
30 ,, ,, 70 ,,	25·40	28·01	2·61

From the results of the experiments it will be seen that, as the percentage of the treacle is increased (the percentage of moisture being also thereby proportionately increased) the residue, contrary to what might have been expected, indicates a small but gradually-increasing excess over the percentage of crystallized sugar known to be present. This cannot be due to the salts and other impurities in the treacle, which are insoluble in the test liquor, for they, as before stated, have already been allowed for. It is highly probable that it is caused by the increasing viscidity of the mixtures and the consequent difficulty of the alcohol, limited in quantity, and approaching nearer and nearer to its saturating point for inverted and uncrystallized sugars, in effecting the liberation of the crystallised portion.

The results obtained in the analysis of the mixtures containing

80 and 90 per cent. of treacle respectively were considerably in excess of the quantity of crystallized sugar present; and it was obvious that the test liquor was inapplicable to the analysis of mixtures containing so large proportions of treacle.

The results accord very well with the theoretical percentages of crystallized sugar in the mixtures down to 50 per cent., but from this point the results are not so satisfactory as could be wished.

In the analysis of samples of sugar, or mixtures of sugar and treacle, in which the proportion of inverted and uncrystallized sugars amounts to upwards of 50 per cent., a test liquor prepared with alcohol of a slightly lower strength than 56 over proof is more suitable, and gives more accurate results; in fact, by gradually reducing the strength of the alcohol, and employing a fresh test liquor as the scale is descended, practically accurate results may be obtained down to the lowest mixture, consisting of 90 parts of treacle to 10 of sugar.

The mode in which the analyses were conducted may be shortly described. To alcohol of the proper strength excess of finely-powdered purified white sugar was added, and the mixture was agitated for two or three days, and, as required for use, the clear saturated liquid was drawn off. 100 grains of the sample were then gently rubbed in a mortar with 200 fluid grains of the saturated alcohol, and the washings thrown upon a filter previously counterpoised with another filter. The operation of washing was repeated nine times, with the like quantity of fluid grains, the sugar in the mortar being gradually transferred to the filter, so that, when the 2,000 grains of the test liquor were used, the whole of the sugar had been transferred to the filter. The counterpoised filter and that containing the crystallized sugar were then dried in a water-bath, and the difference in the weights, after allowing for the salts, &c., present in the treacle, and insoluble in the test liquor, gave the percentage of crystallized sugar in the sample.

My best thanks are due to Messrs. Helm and Stokes for the valuable assistance which they rendered me in making the experiments connected with this investigation.

WHAT IS PASSING IN GERMANY IN CONNECTION WITH THE SUGAR MANUFACTURE.

CONFERENCE OF CHEMISTS CONNECTED WITH THE SUGAR INDUSTRY, HELD AT BERLIN.

LAST August a Conference of twenty-five chemists connected with the manufacture and commerce of sugar, was held in Berlin, under the presidency of Dr. Scheibler.

The aim and object of this Conference was the establishment of uniform and universally recognized bases for saccharometrical analysis, and to take measures for ensuring accuracy and uniform results. This end has been perfectly attained, and various resolutions unanimously adopted respecting the method which shall be generally practised, with especial reference to the analysis of sugar for export, which, as is well known, now constitutes the base of the drawback. Besides this, seven committees have been named for the purpose of settling more exactly some essential points of optical saccharimetry. One of these committees, for instance, has been commissioned to establish accurately the optical rotatory power of different plates of quartz, in connection with that of pure sugar; to make an examination of the other usual accessories of the optical saccharometer, and to prepare a certain quantity of normally pure sugar. The plates of quartz, the pure sugar, &c., to be placed in the central laboratory of the "Association Sucrière," to serve, in the first place, to regulate exactly polariscopical instruments, and also to decide such controverted questions as may be raised; these samples of normally pure sugar to be afterwards sent to the different chemical sugar laboratories.

The report of the committee—consisting of Dr. Scheibler, of Berlin; Dr. Schalz, of Magdebourg; and Dr. Kubel, of Brunswick—will be published in the *Zeitschrift.*

BETAINE, ALKALOID OF THE BEET-ROOT, BY C. SCHEIBLER.

The author has been pursuing his investigations on this singular substance, of which he discovered the presence in beet juice and beet molasses, in 1866. In order to obtain it from the latter, the molasses is first diluted with double its volume of water, then acidulated with chlorhydric acid, part of the foreign substances are then precipitated by a first addition of phosphotungstate of soda, after which a second portion of the same reagent is added, which, after some days, produces a crystalline deposit, that, decomposed by lime, gives "betaine" in solution. The author describes at length the process by which this alkaloid is obtained in a state of purity. "Betaine" is separated from its alcoholic solution under the form of large brilliant crystals containing water of crystallization, and is deliquescent in the air.

"Betaine" is very soluble in water, and its specific gravity is much less than that of sugar. In solution it has no action on polarized light, is inodorous, and does not colour litmus paper. The composition of this crystal is represented by the chemical formula—

$$C_5\,H_{11}\,NO_2 + H_2O$$

The details furnished by the author, up to the present time, on the properties of this new alkaloid, are of purely theoretic interest.

The same author has published some researches on an acid similar to the aspartic, in molasses; but these are as yet, of no practical moment.

ON THE APPLICATION OF THE WALKHOFF PROCESS OF EXTRACTION.

In the last number of the *Zeitschrift*, Mr. Walkhoff gives some directions for the application of his widely-extending process of extraction of juice, which consists, as is well known, in pressing, and after pressure, of separating or sifting the residues of pressure, and extracting by water in closed vessels. The author calculates that nearly ten millions of quintals are the quantity of beet-roots annually subjected to his process. He gives the names of a number of factories in Russia and Poland, and of two in Prussia, where his system has been adopted; and he affirms that the juice extracted by it is superior in purity to that obtained by the diffusion process.

ON THE CHOICE AND KEEPING OF SAMPLES OF RAW SUGAR, BY M. WEINZIERL, OF STETTIN.

Without the exercise of the most minute care in the analysis of sugar, the results obtained by different chemists from the same sugar will not be identical, especially when the samples have not been chosen and preserved with that particular attention, which is by no means general. To show the differences occasioned by the use of card boxes, instead of glass bottles or tin boxes, the author has made some comparative analyses of the same samples kept differently. The samples of sugar were taken from the middle of the cask—one analysis made immediately, the rest of the sugar put away in various sorts of receptacles, and, after remaining undisturbed for 24, 48, 72, and 96 hours, at a temperature of 70 to 85 Far., were then assayed. During the analysis of those marked A in the table, the temperature of the air was 40 to 50 Far., and humid with rain. During the analyses of B and C it was several degrees higher. The pasteboard boxes marked P were 2½ inches in diameter by 1 inch in depth; the others marked G were 3 inches in diameter by 1½ inches in depth, and in other respects were prepared as under:—

1.—Ordinary boxes.
2.—Boxes lined with tin-foil.
3.—Covered with four coats of alcoholic varnish.
4.—Covered with three coats of solution of sugar.

The sugar placed in the tin boxes and glass bottles at the same time did not show any appreciable loss, and are therefore not noted in the following table, which exhibits the loss by evaporation of the sugar in the cardboard boxes.

Experiment.	Mark of Boxes.	Weight of Boxes and Sugar.	Percentage of Loss in Gross Weight after Hours.				Composition of Sugar employed.
			24 h.	48 h.	72 h.	96 h.	
A	P 1	29·95	·86	1·02	1·15		Sugar ......91·30 Water...... 4·01 Foreign matter 4·69
	P 2	90·55	·19	·24	·32		
	P 3	92·00	·43	·57	·74		
	P 4	95·70	·21	·25	·32		
	G 1	144·50	·69	·86	·98	1·44	
	G 2	138·70	·16	·22	·25	·41	
	G 3	140·35	·24	·32	·38	·58	
	G 4	136·20	·11	·14	·18	·29	
B	G 1	153·15	·45	·71	1·03	1·31	Sugar ......91·70 Water...... 3·54 Foreign matter 4·76
	G 2	156·21	·09	·13	·27	·35	
	G 3	156·70	·25	·35	·58	·75	
	G 4	154·51	·09	·14	·28	·39	
C	P 1	95·71	1·12	1·38	1·74	1·91	Sugar ......93·10 Water...... 3·51 Foreign matter 3·39
	P 2	97·35	·39	·45	·61	·72	
	P 3	98·29	·49	·62	·86	1·03	
	P 4	100·40	·32	·39	·52	·65	

The following are the results of the comparative analyses of the sugar in the different boxes on the fourth day:—

	Sugar.	Water.	Foreign Matter.
Analysis made on taking sugar from cask	91·70	3·54	4·76
Sugar from Box 1	92·90	2·28	4·86
,, ,, ,, 2	91·90	3·30	4·80
,, ,, ,, 3	92·40	2·88	4·72
,, ,, ,, 4	91·90	3·31	4·79
Sugar from Tin Boxes	91·80	3·50	4·70
,, Glass Bottles	91·70	3·52	4·78

We thus see that, allowing for slight errors in manipulation, the difference in the two last cases was inappreciable, but that the preparation of the cardboard boxes did not prevent the loss of sugar by dessication, making a noticeable difference in the results of analysis after only three days.

Still greater differences are produced, if particular care is not taken to procure average samples in sugar which has been some time packed, as in this case the low sugar and the syrup are found very unequally mixed in the casks. This may be seen from the following analyses of sugars, which had been warehoused four months :—

	Sugar.	Water.	Salts.	Foreign Organic Matter.
Sample taken from upper end of cask, dry, and of a light yellow colour	92·70	1·79	3·10	2·41
Sample taken from middle of same cask, moist, and darker in colour	90·70	2·86	3·24	3·2
Sample taken from near upper end of cask, dry, and straw coloured	94·20	2·80	1·62	1·38
Sample from the lower end of same cask, very moist, and dark	91·80	3·67	1·98	2·55

In this case we see that it is not only the proportion of water which has been altered, but that the whole composition of the sugar is changed, because of the accumulation of syrups in the lower parts.

M. Schaer has made some observations on the reactions of different sorts of sugar on the blue of Indigo, from which he believes it possible to deduce the distinctive character of beet sugar, some of which he found to contain glucose and an alkali, which he calls ammonia, which latter we rather think will be found in the traces of lime.

THE CONFERENCE ON THE SUGAR DUTIES AT THE HAGUE.

The representatives of Great Britain, France, Holland, and Belgium were recently called together at the Hague, under the 21st Article of the International Sugar Convention of November, 1864, which reserved to the high contracting parties the power of introducing into the Convention, by common consent, any modification not inconsistent with its principles, and the utility of which might be shown by experience.

The Dutch Government had found that the classification of raw sugar in four divisions was inconvenient to the trade of that country, where the duties are very high, and the differences between the rates of the classes proportionately great, especially in the two last classes, the difference between which amounts to about 3s. per cwt. Previous to the Convention the importation of low sugars was impossible under the one high uniform rate; but since the introduction of classified duty, under the Convention, as might be expected, a change has taken place, and low sugar is now frequently imported, and with easier gradations would, it is asserted, be introduced in still larger quantities. The Dutch Government, therefore, were anxious to modify the system laid down by the Convention by subdividing the four classes, still, however, preserving the same proportions of duty. In England, however, where the duties on raw sugar are less than half those levied in Holland, the inconvenience arising from the extent of difference between the rates is not sufficient to compensate for the great complication which a further division of classes would create, or for the derangement of trade that any change of duty would produce. The English representatives, therefore, declined to accept such a modification as compulsory, but expressed their willingness to consent to allow any of the other contracting parties to adopt it, if they thought fit, on the express understanding that the subdivision should still be within the existing limits of the classes, and that the average duty of each class, as fixed according to the result of the Cologne experiments, should not be altered, This arrangement was accepted by Holland, and agreed to by the representatives of France and Belgium, and accordingly adopted by the Conference.

The most important matter, however, which was brought before the Conference was the action of France in carrying into execution the requirements of the Convention. It will be remembered that France, like Belgium and Holland, at the time the negotiations that led to the Convention were commenced, levied one uniform rate of duty upon raw sugar; but in May, 1864, this rate was changed for a divided duty of 42 francs per 100 kilos upon raw sugar below No. 13, Paris standard, and 44 francs upon sugar above 13, up to No. 20.

The Convention was intended to abolish the large bounties granted by France and the other countries to their refiners, in the shape of drawback on the exportation of refined sugar, and therefore it was made more stringent in regard to drawbacks than duties, it being necessary to allow a certain freedom in regard to the latter, as in all countries the sugar duty forms an important and leading article of revenue, and consequently is one upon which financiers find it convenient to operate, according to financial necessities. As there was some doubt how far France might be inclined to adopt the proposed system of duty in lieu of her two rates, the representatives of the other countries took especial care to stipulate that the duty upon refined sugar imported into France from their respective countries should not be greater in France, in proportion to the raw sugar duty, than in their own countries; and with this view, the proportion of duty to be charged in France on refined sugar imported from the other contracting countries was, as it was thought, clearly defined by Article 13 of the Convention, and by this Article that duty was immediately to be reduced from 55 francs per 100 kilos to 50·60 francs; and after the completion of the Cologne experiments it was to be again altered, either by reduction or increase, according to the results of those experiments.

In carrying out the stipulations of the Convention, France adopted the scheme of classification as laid down by the Convention, so far as regarded the exportation of refined sugar, but declined to make any alteration in the duties of importation on raw sugar, and effected this arrangement by treating sugar which was intended to be refined for exportation differently from that which was to be refined for home use. In the latter case the duty was, of course, to be required; but in the former the sugar was to be assessed under the scheme of four classes, and delivered free of duty, on bond to export the quantity of refined sugar required for the class to which the raw sugar belonged, under the Convention. Subsequently, upon the completion of the Cologne experiments, the results rendered it incumbent on France to make a further reduction of the duty on refined sugar imported from the other contracting countries; but it was argued by the French Government that, as the average yields of the whole of the four classes was exactly the same as in the temporary scale adopted pending the experiments, they were not called upon to make any change. Great Britain, Holland, and Belgium remonstrated against this dictum, and the French Government, after a lengthened correspondence, requested that the question might be referred to the representatives of the different countries who drew up the Convention. This request was complied with, and the Conference again met last year at the Hague. At that meeting statistics were produced to show that if the full extent of reduction required by the 13th Article were insisted upon, foreign refined sugar would enter France at a lower duty than that paid by French refiners on their raw sugar; and this fact having been established, it was agreed to accept a modified reduction to 48·85 francs per 100 kilos, until 1st January, 1870, at which date the extra duty upon raw sugar imported into France in foreign ships was to be abolished, as well as the deduction of duty (détaxe) in favour of French colonial sugar; and also on the understanding that the French Government would in the meantime introduce a law to adopt the classified duties, and thus give full effect to the whole of the stipulations of the Convention.

At the recent meeting, however, the French commissioners explained that the important organic changes in the internal government of their country had necessarily so completely engrossed the attention of the Government and Legislature, that it had been found impossible to introduce the promised law, and that the same cause would render it impossible to attempt it before the session of 1871, but that the Imperial Government were prepared to do so at the earliest opportunity; they therefore appealed to the good feeling of the other Governments to consent to a further postponement of the alteration of the duties till January, 1871. They stated, at the same time, that the extra duty levied, in protection of their own ships, on sugar imported in foreign ships, and the "détaxe," or deduction of duty in favour of their colonial sugars, had both been abolished, and that there was no probability of the renewal of such measures.

The other matters brought before the Conference were of no great importance. The French asked to alter the restriction contained in Article 10, by which sugars of a lower quality than No. 10 cannot be exported, and they desired to permit the exportation of sugar as low as No. 7, to which there was no material objection. The last matter was the comparison of the standards approved in 1865, for the assessment in all four countries. It was found that the clayed and beet-root samples had been slightly deteriorated by keeping, and it was determined that they should be renewed.

This formed the whole business of the Conference.

The following table shows the rates of duty charged in the three countries upon the importation of sugar:—

	HOLLAND.	BELGIUM.	
	Florins (1s. 8d.)	Fr. C.	
Refined	27.	51.13	per 100 kilos.
Raw, 1st Class	25.38	48.07	,,
,, 2nd ,,	23.76	45	,,
,, 3rd ,,	21.60	40.91	,,
,, 4th ,,	18.09	34.26	,,

FRANCE.

	Fr. C.	Fr.	
Refined	48.85		
Unrefined under No. 13 Paris Standard		42	per 100 kilos.
From 13 to 20		44	,,

In Holland and Belgium drawbacks are the same as duties.

FRENCH CENTRAL FACTORIES.

To the Editor of "The Sugar Cane."

Dear Sir,

I have recently read with much interest an account of a tour through Guadaloupe, made by Mr. Wm. Russell, of Demerara.

This visit was undertaken with a view of examining into the state of sugar cultivation and manufacture in the French Antilles, and more especially of obtaining some knowledge of the working of the "Usine," or "Central Factory" system, so extensively adopted there; and of inquiring whether this system could beneficially be introduced into Demerara, or other English colonies.

Mr. Russell, it is evident, has very carefully studied the problem he has proposed to himself, and has put very much of really valuable information into a small compass, while he draws attention to many points in which our English practice might with great advantage be assimilated to the French system.

The most interesting portions of his pamphlet are, however—first, that in which he lays before us the percentages of sugar which the "Usines" claim to obtain from their canes, the cost of canes and manufacture, and the profit made; and next, that in which he makes use of the data to show on what conditions the Central Factory system might profitably be introduced into Demerara.

My object in writing this letter is not to question the facts and figures given by Mr. Russell (though some, at any rate, of these are, I believe, fairly open to criticism); but, taking these facts and figures as absolutely correct, I wish to place beside them other facts and figures equally unquestioned, which I believe will show clearly that, however profitable (and Mr. Russell's figures show that it is *very* profitable) it may be to buy canes, and to manufacture them into sugar in "Usines," or Central Factories, furnished with the Triple Effect Apparatus, with its attendant air pumps, steam boilers, &c., it is much *more* profitable to buy canes and to manufacture them into concrete, *or sugar*, in Central Factories furnished with the Concretor, and, if desired, with the centrifugal machine also. Fortunately, during the last crop a Concretor was in operation in Guadaloupe. As it is probable that the juice upon which it operated was very similar to that obtained in the "Usines" (though the mill supplying it is much less efficient), we may compare the results obtained with this Concretor with those obtained in the "Usines" *with certainly no unfairness to the "Usines."* If the mill supplying the Concretor expressed 5 or 6 per cent. less juice from the canes than was obtained by the "Usines" mill, so much the worse for the Concretor.

I find it stated by Mr. Russell that from every 100 lbs. of canes the "Usines" obtain a total of 9·58 lbs. of sugar, of which only 6·67 lbs. are 1st sugar.

In a letter written by Mr. Cottin (the possessor of the Concretor in Guadaloupe), and which appeared in the first number of "*The Sugar Cane*," page 59, he stated that from every 100 lbs. of canes he obtained 13 lbs. of concrete; and from another source I further learn that when he put this concrete through the centrifugal he obtained 66 per cent. of its weight, or 8·66 lbs., per 100 lbs. of canes, of 1st sugar. This is *nearly* 2 *lbs. more* of 1st sugar than the Usines made, and *within a pound* of their *total* yield of sugar. It might possibly be objected that the concrete centrifugaled 1st sugar would not be equal in quality to the "Usines" 1st sugar. To this I reply, that it must be remembered that obtaining more 1st sugar from the same juice means, *and can only mean*, that the juice has been less injured during the process of evaporation. The concrete centrifugaled 1st sugar ought, therefore, in the nature of things, to be *better* than the "Usines" 1st sugar, *so far as injury during the process of evaporation and concentration is concerned.* In the "Usines," however, the juice is passed through animal charcoal, and to this treatment the fine colour of the "Usines" sugar is chiefly due. If, therefore, we desire that the concrete centrifugaled 1st sugar shall be *finer* than the "Usines" 1st sugar (as we have a good right to expect that it may be), we must adopt the same system of purification and decoloration which they adopt and we must pass the liquor destined to make concrete centrifugaled 1st sugar, through charcoal, as the "Usines" pass their liquors through charcoal.

I do not now enter into the question of whether it is worth while to pass the liquors through charcoal. This question is foreign to my argument, and depends solely upon the question whether the increased value consequent on a better colour is a sufficient compensation for the additional outlay of capital, and the extra working expenses which must be incurred where charcoal is used.

As Mr. Cottin did not again boil down the molasses drained from his 1st sugar, I cannot give the quantities of 2nd, 3rd, and 4th sugars, which he might have obtained; but there is no doubt that had he reboiled his molasses, the total quantity of sugar which he would have made would have *greatly* exceeded the total quantity obtained by the "Usines," while I have already shown that in using the same precautions as to purification his qualities would be superior.

I have given the result so far as the *product* is concerned. As regards the expenses of manufacture, these would certainly be *greatly* in favour of using the Concretor instead of the Triple Effect, while the first outlay for machinery would also be much less where the Concretor was employed.

It must be remembered that when Mr. Cottin obtained these results, he himself affirmed that his men had not had time to learn how to work the Concretor to the best advantage, and that he expected to obtain even better results in the future.

The foregoing is written on the supposition that the Concretor is used to make sugar of fine quality.

Now, let us look at another method of using this machine, and compare the making of Fryer's Concrete with the figures which Mr. Russell gives as the results which could probably be obtained in Demerara.

He states that the value of 30,000 lbs. of canes manufactured into vacuum pan sugar, molasses, and rum would be 134 dols., and of this sum he estimates that 48·60 dols. would be profit.

With juice gauging 10° Baumé, we regularly obtain on estates in which I am interested in Antigua 13 per cent. of the weight of canes in concrete. The juice which Mr. Russell supposes his canes to yield gauges 10¾° Baumé. Let us suppose, however, that even this sweeter juice only yields 13 per cent. of concrete. From the

30,000 lbs. of canes we shall then obtain 3,900 lbs. of concrete. Mr. Russell reckons his sugar as worth 7 dols. the 100 lbs.* We shall therefore certainly not be over the mark if we reckon our concrete as being worth 4 dols. the 100 lbs. † This gives 156 dols. as the worth of the concrete, or 22 dols. more than the worth of the sugar, molasses, and rum, according to Mr. Russell's estimate.

If, however, it is wished to run down the worth of concrete to a ridiculously low figure, take 3½ dols. per 100 lbs. as its value. This price will still give 136½ dols. as the worth of the concrete, or 2½ dols. more than that of the sugar, molasses, and rum.

In each case the cost of the canes will of course be the same, while the other expenses—such as cost of manufacture, coal, &c.—will be *greatly* in favour of concrete. The difference in the amount of capital required for the one system and for the other will also be decidedly in favour of concrete. *A fortiori*, the return per cent. on the capital employed will be largely in favour of concrete.

I set out with the intention of proving that the clear profit to be obtained by using the Concretor was at least as great as by using any other system whatever; while, as the capital required where the Concretor is used is less than that required for any other, except the very rudest, system, the profit *per cent.* would necessarily be largest where the Concretor was adopted.

My facts, carried out to their logical conclusions, have, I find, landed me even further than the point at which I aimed, and to have attained which would have satisfied me.

Hoping that the comparisons I have instituted may prove interesting to some of your readers,

I am, dear Sir,
Yours truly,
JAMES B. ALLIOTT.

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* Equal to 32/8 per cwt. in the colony, or more than 35/6 nett in bond landed in England—a price exceeding that of the average of *loaf sugar in bond in Europe*, and obviously far too much for the average quality of Usine sugar, first crystallization. The French colonists enjoy a protective drawback of 2/- per cwt. (see *Sugar Cane*, page 119), which raises the price of Usine sugar in the colony. Count d'Adhemar places the average price of Usine sugar at 22/2 per cwt. in the French Antilles.—*Ed. S. C.*

† Or 18/4 per cwt. in the colony. The average price of Antigua concrete in the colony for 1869 has been 18/7.—*Ed. S. C.*

THE BEET-ROOT SUGAR CROP IN FRANCE.

(*From the "Journal des Fabricants de Sucre.*")

The official table does not furnish us with any great amount of intelligence, but we have ample accounts in private letters, from which we are permitted to supply information to satisfy the legitimate curiosity of our readers. In the Department du Nord the crop is good, and the yield per hectare seems to be generally a fourth or a fifth in excess of last year, which, as we know, was below the average. The yield of the juice there is excellent. Those who obtained 5 per cent. of sugar last year are this year getting 6 per cent. at least. We shall not be surprised if the production in this department for the present season reaches 80 millions of kilos. In the Pas de Calais the crop is very variable—here deficient, there in excess; but on the average it will be nearly a fifth less than that of last year. The same may be said of L'Aisne; in La Somme things are a little better, but still worse in L'Oise, where the deficiency will be a third or a fourth, compared with last year. In the other departments outside the general sugar-producing districts we do not think there will be any appreciable deficiency; on the contrary, we can mention some districts—the Puy-de-Dome, for instance—where the beet-root crop leaves little to be desired, either in quality or quantity.

As regards the juice, there is a large yield of syrup, which produces sugar in abundance. In this respect the reports are generally unanimous as to the excellent results this year. With few exceptions, nearly 1 per cent. more sugar will be obtained from the beet.

We must nevertheless admit—the fact is not surprising, considering the cold and the dry weather—the statement that the beets are not very juicy, and that it requires a larger quantity of roots than last year to produce a hectolitre of juice. The pulp will be abundant—an increase of 5 or 6 per cent., and, as a necessary consequence, there will be a corresponding reduction in the yield of sugar, which otherwise would be still greater than what we have above stated.

We are aware that our calculations are at present hypothetical; nevertheless, thanks to the new elements we possess, we may with greater certainty than we could some days ago estimate the probable figures of the production. The calculations we have made for every department, and taking account of the crop being here deficient and there in excess, reckoning on the greater richness of the juice on the one hand, and allowing for the greater proportion of pulp—in a word, considering carefully and conscientiously all the details in our possession, we always arrive at 230 millions of kilos, a figure to which we hold, remarking, nevertheless, that we now incline to consider this rather as a minimum than as an average, and that it is not impossible it may be exceeded by some millions.

The beet harvest is being gathered in under very favourable conditions of temperature, &c., and the cold weather which has prevailed for some days is propitious for the extraction of the juice, and for the preservation of the roots; consequently, the delivery to the manufactories and the placing in the pits is being pushed forward. Thus, as we have said above, although, with the exception of in the Nord, there is a deficiency in the crop, yet, as there is reason to be satisfied with the yield of sugar from the juice, which will be nearly 1 per cent. greater than last, we maintain for France our estimate of 230 millions.

In Belgium the production will probably be below the amount estimated, although the crop is satisfactory and the quality good. In the Zolverein there are very great inequalities in the yield. The average crop will be below that of last year, but we are satisfied that the produce of sugar will reach 200,000 tons. The news from Austria are not so good as regards yield and quality as the announcements lately made.

TABLE SHOWING THE EXPORTS OF SUGAR FROM THE MAURITIUS FOR THE LAST TWENTY-SIX CROPS, WITH THE PERCENTAGE TAKEN BY EACH COUNTRY.

	United Kingdom.	France.	Australia.	Cape.	India.	Other places.		Total exported.
	Per cent.	Per cent	Per cent.	Per cent.	Per cent	Per cent		Tons.
1843-44..	95·6	Nil.	·36	4·	Nil.	·04	=100	26,852
1844-45..	93·66	,,	4·7	1·6	,,	·04	=100	34,894
1845-46..	92·83	,,	4·0	3·15	,,	·02	=100	45,611
1846-47..	93·6	,,	2·89	3·23	,,	·27	=100	59,558
1847-48..	84·4	,,	8·4	7·	,,	·2	=100	54,834
1848-9 ..	88·4	,,	7·	4·59	,,	·01	=100	47,442
1849-50..	89·	,,	5·4	5·2	,,	·4	=100	53,805
1850-51..	91·	,,	4·7	3·6	,,	·7	=100	52,271
1851-52..	83·6	,,	6·7	9·6	,,	·1	=100	61,328
1852-53..	85·3	,,	10·05	4·6	,,	·05	=100	72,022
1853-54..	85·2	1·6	11·3	2·9	,,	·44	=100	90,744
1854-55..	69·7	11·8	12·0	5·1	,,	1·4	=100	98,441
1855-56..	77·4	7·3	12·6	2·55	,,	·15	=100	102,715
1856-57..	56·4	21·9	16·9	3·2	,,	1·6	=100	99,314
1857-58..	53·6	15·7	22·6	5·4	,,	2·7	=100	97,356
1858-59..	56·	17·6	20·	4·4	,,	2·0	=100	106,204
1859-60..	47·7	26·4	19·3	4·4	,,	2·2	=100	101,317
1860-61..	68·2	10·1	15·8	3·4	,,	2·5	=100	121,428
1861-62..	37·5	22·8	30·5	5·8	,,	3·4	=100	98,401
1862-63..	49·3	20·2	20·5	4·0	,,	6·	=100	154,629
1863-64..	48·5	15·	24·4	3·9	8·	0·2	=100	108,676
1864-65..	45·0	18·8	23·5	3·5	8·8	·4	=100	116,077
1865-66..	54·5	1·5	28·7	2·	12·7	·6	=100	107,809
1866-67..	23·7	5·2	46·4	3·	20·8	·9	=100	96,640
1867-68..	44·0	1·4	29·7	1·6	22·7	·6	=100	113,612
1868-69..	28·3	6·8	46·3	·9	16·9	·8	=100	74,800

The above table, adapted from one in Mr. Millard's work on "The Sugar Industry of Java," and corrrected from other sources, suggests several interesting considerations. In the first place we may remark the great advance in the sugar production of Mauritius. In twenty years, from 1824, the exports had increased more than fourfold, since which time they have remained, on the average, nearly stationary. Then we may observe the gradual, but great change in the destinations of the crops; thus, in 1843-44, the United Kingdom received 95 per cent. of the quantity exported, and in 1868-9 only 28 per cent., whilst India and Australia have of late years taken more than half the crop. The exports to France, which for four seasons ending 1864-5 had averaged about 20 per cent., have not during the last four averaged 4 per cent.

The development of markets nearer the island will partly account for this; also, the great increase in the growth of beet-root in France. But it may also suggest that—to some extent, at least—the cost of producing fine white sugar militates against its competition with refined sugar, even when duties are favourable; and that the possession of markets near at hand, where there is comparatively little competition of any kind, is necessary for the success of manufacturing fine sugars in the colonies.

ON A NEW METHOD OF TREATING SUGAR AND MOLASSES, BY MEANS OF WHICH THEIR DECOLORATION, PURIFICATION, AND CLARIFICATION MAY BE EFFECTED WITHOUT EMPLOYING ANIMAL CHARCOAL OR ALBUMEN—*Note of M. C. Woestyn, presented to the Academy of Sciences by M. Balard.*

From "La Sucrerie Indigene."

THE sugar being dissolved to a degree Baumé which may vary according to the custom of the refinery, milk of lime is introduced in proportion, larger as the sugar is less pure. The quantity used is reckoned by thousandths for the finer qualities of sugar and increases progressively to hundredths for sugar of low quality. After the lime has been intimately mixed with the syrup, a stream of carbonic acid is introduced, and continues flowing until the test paper shows no further trace of alkalinity.

The above operations must be carried on at a low temperature in order to obtain the maximum effect. In my manufactory I operate at from 20° to 30° Cent. (70° to 85° Fahr.) The operation is finished by boiling, of which the object is to disengage the bicarbonates. The next process is mechanical filtration, which I effect by means of filter presses; or, when the liquor is not too dense, by decantation.

The shade of colour of the syrups thus obtained is reduced to half, or a third, or a fourth of the original shade, according to the quantity of lime employed, for the more this proportion is increased the greater is the effect obtained. In operating, for instance, on sugars of a lemon colour with 4 per cent of lime by this process white syrup is obtained, which may be boiled directly for refining. The savour of these syrups is perfect, and they do not retain any of the disagreeable taste of the sugars from which they are obtained. The clarification is also as complete as possible, the new syrups filter easily, and have all the brilliance and limpidness which can be obtained with blood or white of egg, and they boil much more easily.

I have already noted the last effect in a memoir on the dangers of employing putrid blood in the manufacture of an edible commodity like sugar, which memoir I addressed to the Imperial Academy of Sciences of St. Petersburg, and which the Academy deemed worthy of commending to the attention of the Medical Council of the Empire, since when most Russian refiners have abandoned the use of blood in the manufacture of refined sugar. This question had a special importance in Russia, on account of the existence of so many sects in the empire, especially amongst the population on the borders of Asia, who, from religious scruples, refuse to consume sugar prepared with blood.

It is necessary, in order to explain the preceding reactions, to state that the carbonate of lime, which has birth in the syrups, forms with the colouring matter therein contained an *insoluble* compound. Of this we may be assured by examining the deposit after frequent washing; it has then a colour like that of the sugar from which it was originally obtained. The like effect has been produced on the matters which dulled the transparency of the syrups, which after the operation were perfectly clear.

I will not conclude without calling attention to this fact—that in this process the syrups may be completely saturated with lime without any fear of the calcareous deposit becoming re-dissolved in the syrup. In the process of purification of beet juice, on the contrary, it is well known that an excess of lime and carbonization leads to a re-dissolution of the deposit produced. We are thus constrained to admit that a radical difference exists between the colouring matter of the yellow sugar and that of beet juice, or that in the latter there are matters which render the deposit soluble when an excess of lime is used.

LA UNION.

We have been favoured with the following letter for publication; its contents will show to how large an extent the commerce of the Western Republics of South and Central America is extending, and that the facilities of transport to Europe from the Pacific coasts direct and *viâ* Panama are being greatly increased:

Amapala, September 8, 1869.

Mr. Robert Buchanan,
Dear Sir,

Since writing to you last, we received some interesting letters from California, stating the importations of sugar and coffee into that country to increase beyond all calculations and anticipations, on account of the opening up of a large market for those articles in the most western states and in the northern provinces of Mexico. We call your attention to the statistics of exports from the states of Guatemala and Salvador, and you will find that the amount of sugar shipped from these two states to California has increased 100 per cent. during the last year, and there is no doubt that, in proportion as the facilities for carrying have become greater, California and its dependencies (the whole far west) will require much more sugar than the Sandwich Islands and Central America are producing. Prices of all grades of sugar have rated in general much higher in California than in any other part of the world, and its short distance from Central America assuring cheap freights, exporters of any kind of sugar from this country will find most advantages in the California market; and, as already two large refining establishments are in operation at San Francisco, concrete will even be appreciated in California, as it is already in Europe.

But even the exports to Europe of sugar and all other produce from these republics receiving every day more attention, are made, consequently, at much less expense than formerly. Muscovada sugar has been shipped from the more northern ports during the last season already per steamer through to Liverpool for £5 per 2000 lbs., reaching England generally about 35 days after embarkation on this coast; and sailing vessels chartered for a round voyage can generally be had for £2 10s. for the home cargo, and sometimes even for less.

We have been informed that the Panama Railroad Company intends to make a reduction of about 25 per cent. in their freight rates also, a new facility for exporters.

In view of the above, we should think your friends will find the same facilities for freights from this coast almost as from the Antilles, and certainly will the greater yield of cane more than recompense for any small difference in freight rates.

Yours very truly,

Morris & Co.

Estimate of the Beet-Root Sugar Production of the Present Season Compared with that of the last Three Years.

From "Licht's Monthly Circular."

	1869-70. Tons.	1868-69. Tons.	1867-68. Tons.	1866-67. Tons.
Zollverein	200,000	208,000	165,000	201,000
France	240,000	214,000	225,000	217,000
Austria	85,000	72,000	93,000	90,000
Russia	90,000	65,000	97,000	82,000
Belgium	40,000	37,000	31,000	39,000
Poland and Sweden	22,500	22,000	15,000	19,000
Holland	12,500	10,000	7,000	6,000
	690,000	628,000	633,000	654,000

THE IMMIGRATION SEASON.

The Indian emigration season of 1869-70 has opened with very encouraging prospects. The first vessel despatched from Calcutta was the screw steamship *Far East*, which sailed on the 24th July for Demerara. Since then several other ships have been despatched, principally for Demerara. From the particulars of these ships, which are given below, it will be seen that the proportion of females to males has been maintained at a high, and therefore satisfactory, ratio. Besides those ships that have already been despatched to Demerara, the following had been chartered at Calcutta, on August 26, for the conveyance of coolies to the same colony, viz.:—*St. Kilda*, at £12 10s.; *Forfarshire*, at £12 10s.; and the *Sophia Joakim*, at £12.

Coolie Ships from Calcutta to Demerara.

Ship.	Sailed.	Men.	Women.	Boys.	Girls.	Infants.	Total Souls.	Statute Adults.
Far East.	July 24	329	154	..	..	....	483	431
Adamant.	Aug. 10	213	92	28	17	22	372	
Medea ..	Aug. 27	251	139	24	27	31	472	
India ..	Sept. 1	237	88	16	21	31	393	
Shand ..	Sept. 3	199	136	43	36	44	458	

From Calcutta for Trinidad.

The *Varuna*, on the 5th of August, with 413 Statute Adults.

Further information has been received of the despatch, on the 14th August, from Calcutta for Trinidad, of the ship *Beaumaris Castle*, having on board 192 men, 142 women, 72 boys, 54 girls, and 24 male and 19 female infants, making a total of 503 souls, equal to 397 statute adults.

NEW BOOKS.

The Fall of the Sugar Planters in Jamaica, with Remarks on their Agricultural Management, and on the Labour Question in that Island. London: Trübner & Co., 60, Paternoster Row, 1869.

Jamaica is a stock subject with essayists and pamphleteers, and since the outbreak of 1865 numberless brochures have appeared, in which every variety of opinion has been advocated with more or less ability.

This pamphlet, as the author informs us in the introduction, consists principally of a reprint of an article contributed by the writer in 1867 to the *Westminster Review*, and contains a sketch of the industrial system and condition of the sugar plantations of Jamaica in the time of slavery, and of their decay at a later period, both previous and subsequent to its abolition; together with an exposition of the barbarous manner in which the planters commonly cultivate the sugar plantations at the present time, namely, according to the practice prevalent under slavery, and with scarcely any amendment.

The author endeavours to show that the adversity complained of by the sugar planters of Jamaica is by no means merely of late date, but that it has been chronic during the last 100 years. That their prosperity had begun to decline as early as 1772; that in 1792 insolvency was a general calamity; that in 1804 most of the British merchants holding securities in the island foreclosed; that on the abolition of the slave trade in 1807, one-fourth of the sugar estates were thrown up or brought to sale; that in 1811 plantation after plantation passed into the hands of mortgagees or creditors absent from the island; and that the abolition of slavery was not needed to complete the ruin of the sugar planters, this being evident from the fact that the six millions sterling which they received as their share of the compensation, instead of being employed as capital for working the estates, mostly went to pay off debts and mortgages.

"The original settlers," we are told, "were an industrious, hard-working, enterprising race," who resided on their own properties, and vigorously conducted their own affairs, and the price of sugar being then very remunerative, with an unlimited supply of labour at command, they were of course prosperous, grew rich, and returned home, and became instead of planters, West Indian proprietors, living with the noble and wealthy of the land, and contracting aristocratic habits gradually adopted the system of encumbering their estates by marriage settlements, rent charges, and the like. Thus, when sugar fell to more moderate prices, they became embarrassed—every fiscal change to their disadvantage increased their difficulties, and finally, when slavery was abolished, a great many of them were hopelessly involved.

So much for the more remote sources of the decline of the sugar culture; as regards the more recent and immediate causes of its fall, the author alleges that after abolition the same system of culture was continued, that the planters obstinately persisted in the barbarous mode of tillage previously practised, that all recommendations of improved methods adapted to the economic use of hired labour were scouted with supreme contempt, that capital was expended in keeping hired labourers nearly as numerous as were employed as slaves, and that no means were taken to renovate the exhausted soil of the limited amount of land in the island adapted to the growth of the cane. On the labour question he takes the side of the negroes entirely, denying their disinclination to work for wages, and yet defending their preference for cultivating their own small estates. The distrust which so generally exists between them and the planters he considers is entirely the fault of the latter. He is strongly opposed to all immigration schemes, which he states have hitherto been failures in Jamaica; in his opinion if improved modes of culture and manufacture were generally adopted there would be far less manual labour required than is now employed.

The author has furnished much interesting information, but we think his conclusions are not always in accordance with his facts, and like all one-sided writers he is not always just.

De Concretor. De nieuwe Suikermachine uitgevonden door Alfred Fryer, suikerfabriekant en Raffinadeur, &c. Zalt-Bommel, Joh. Noman & Zoon. 1869.

It is somewhat exceptional for English sugar literature to be translated into any continental tongue; but this book is a reproduction in Dutch of the substance of the various papers which have been published on the Concretor in English and French; amongst the rest of Count d' Adhemar's pamphlet on Fryer's Concretor, Pere Labat's system and central factories.

"*Fryer's Concretor.*" Overgedrukt uit den Java—Bode, 1869, another work in Dutch on the same subject—a reprint in Java of some articles, by a resident planter, which appeared in a Java newspaper.

STOCKS OF RAW SUGAR IN THE CHIEF MARKETS OF THE WORLD, IN THOUSANDS OF TONS, TO AUGUST 31.

	1869.	1868.
United Kingdom	122	122
France	33	52
Holland	36	51
Zollverein	2	2
United States	146	116
Cuba	53	57
Total	392	400

CONSUMPTION IN EUROPE AND UNITED STATES FOR YEAR ENDING AUGUST 31.

	1868-9.	1867-8.
Europe	1243	1176
United States	406	404
	1649	1580

NEW PATENTS.—FROM THE MECHANICS' MAGAZINE.

722. G. H. T. Finzel, Bristol. *Cooling charcoal.* Dated March 9, 1869.

The inventor cools and sifts animal charcoal after it has been reburnt, and at the same time raises it to the desired elevation by feeding it into a pipe or shaft up through which a current of air is caused to pass. The current of air is sufficiently rapid to carry the charcoal along with it, and the charcoal is by this means raised to the desired height at the same time that it is cooled; the upper end of the pipe or shaft opens into a chamber, and the charcoal as it issues from the shaft or pipe falls upon the floor of the chamber, whilst the dust passes off with the air into a second chamber, where it is collected.—Patent completed.

1073 A. Fryer, Manchester. Dated April 8, 1869.

The inventor constructs a truck, which he prefers to make entirely of metal, and which is usually furnished with only two wheels keyed fast upon their common axle. This axle projects through the wheels on each side, and at each end of it is placed a bracket resting in a bearing upon it, and hanging down nearly to the lowest part of the circumference of the wheel. Each of these brackets terminates on the outer side in a flange or step, which he prolongs in such a manner that by slightly inclining the bracket its edge comes in contact with the ground. When in position he is enabled to draw the wheels of the cart containing the canes or beetroot on to these flanges, where, when the brackets are again brought to a vertical position, they rest, and the carts thus freed from the ground and resting on the trucks are drawn along the tramway. Several of these carts are usually formed into a train, the fore part of the one being supported by the hinder part of the adjoining one.—Patent completed.

We regret to hear of the death of Mr. George Gordon, the well known refiner of San Francisco.

SUGAR STATISTICS—GREAT BRITAIN.

To 23rd Oct., 1869. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	17	1	1	9	29	53	86	9	12	42	148	184	88	10	13	41	152	156
British East India	9	5	..	..	14	5	14	6	..	..	21	5	10	5	..	..	15	9
Mauritius	3	..	..	..	4	6	8	1	5	4	18	36	11	1	5	5	22	36
Cuba	11	2	2	18	32	34	16	13	23	54	106	121	11	13	21	48	94	101
Porto Rico, &c. ..	4	1	1	1	7	5	6	9	2	3	20	16	4	9	1	2	17	15
Manilla, &c.	42	8	..	1	50	47	29	17	1	2	49	40	17	19	2	1	39	34
Brazil	1	11	2	3	17	26	1	29	14	15	59	57	2	34	13	15	63	48
Beetroot, &c.	1	..	..	..	1	2	12	4	1	11	26	32	13	3	1	10	27	37
Total, 1869 ..	88	29	5	33	155	176	172	88	56	131	446	491	156	96	56	122	430	435
Total, 1868 ..	85	47	6	39	21 decrease		180	94	50	168	45 decrease		167	84	50	140	5 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

Good descriptions of raw sugar have, on the whole, fully maintained their prices during the past month. In the earlier part prices were rather in favour of sellers; but, owing to numerous offers of new beet sugar from the Continent, chiefly for forward delivery, at relatively low prices, the market for Colonial was temporarily depressed, especially for low descriptions. Latterly there has been a brisk demand for refining purposes, and considerable activity prevailed, higher prices being paid for the better descriptions, which at the close of the month remain decidedly firm. Refined goods have shared in these slight fluctuations.

The decrease in imports and stocks in the United Kingdom up to the latter end of October, as compared with last year, is about the same as it was a month ago, the decrease in stocks being entirely of the better sorts of raw sugars; on the other hand, deliveries show a rather larger relative decrease.

The Continental Beet Sugar Crop is still estimated by the best authorities at 60,000 tons in excess of that of last year; but even this large increase, when set against the diminished stocks in Europe generally, will leave little reliable overplus, and as imports from various parts have been unusually early this year, stocks of cane sugar in the United Kingdom will probably show a further relative decrease during the winter, unless there are much larger supplies than last season from Mauritius and other Eastern sources.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

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☞ The writers alone are responsible for their statements.

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ON THE CHEMISTRY OF SUGAR REFINING.

By Dr. Wallace, F.R.S.E., Glasgow.

A Discourse delivered before the Fellows of the Chemical Society, February 4, 1869, and Revised by the Author for Publication in "*The Sugar Cane.*"

The considerations which have induced me to bring before you the chemistry of sugar refining, are these:—First, the industry is one of very great importance; secondly, the trade has for some years been affected seriously by foreign competition; and, thirdly, the refineries in London, formerly the principal seat of refining in this country, have for some time suffered from a very great depression, in some cases almost threatening annihilation.

As regards the extent of the industry in this country, a few statistics will suffice. According to the Board of Trade returns for 1868, the importation of sugar of all sorts amounted to 594,656 tons, or, in round numbers, 600,000 tons. This is charged at various rates of duty, but, if we take 9s. per cwt. as the average, the total revenue to the State from the import of sugar will amount to nearly 5½ millions, and the total money value of the sugar, including duty, to about £21,000,000. I am not able to state what proportion of the quantity I have mentioned, enters into direct consumption, and how much is refined, but I think I am safe in saying, that at least 400,000 tons per annum are refined in this country.

The competition of foreign countries, particularly France, is entirely in loaf sugar, the quantity of which imported in 1868 was 34,039 tons, while the previous year it amounted to 42,047 tons. This is an alarming fact, and one that deserves the earnest attention both of our refiners and of our legislators. Either our refiners are far behind in the march of improvement in manufacturing processes, or the French refiners possess an unfair advantage in the shape of drawback on duty, which is equivalent to a premium offered by the French Government to the exporter of loaf sugar. That the latter is the fact I have attempted to show in a discourse recently published, and I will not occupy our time with a repetition of it. If our refiners are really backward in adopting means to keep up with the times, they deserve to succumb to the superior knowledge and skill of their continental neighbours; but if the other explanation of the enormous importation of loaf-sugar is the true one, then our Government ought to take steps to have the cause removed, and our own countrymen put on terms of equality with the French refiners. Besides the drawback on duty, to which I have referred, the French have a protective duty on foreign refined sugar, which makes it impossible for our refiners, under any circumstances, to export refined sugar to France.

Then, as to the depression of the trade in London, I think it depends upon a number of circumstances, but mainly upon the extraordinary development of the industry within the last few years in Greenock and Glasgow. In 1857, the quantity of sugar refined in the Clyde was 38,336 tons, while in 1867, it rose to 178,013 tons, or considerably more than four times the amount. Last year the quantity refined was rather less, being only 171,643 tons, but even this is fully two-fifths of all the sugar refined in the United Kingdom. At present there are sixteen refineries in the Clyde, viz., thirteen in Greenock, and three in Glasgow, of which two in each place are standing idle or building, and besides these, there was refined last year about 11,000 tons by one house in Leith. Now, there are in London twenty refineries, in Liverpool eleven, in Bristol four or five, in Plymouth two, in Manchester two, in Newcastle-under-Lyne one, and in Dublin one; but of those in the metropolis, a considerable number are doing nothing. It appears to me that the London refiners generally have been somewhat tardy in adopting the most recent improvements introduced in the provincial refineries, and they have been unwilling to give up the making of loaf-sugar, which has not lately been profitable, for the reason I have named; and besides, they work under the disadvantages of dear labour and water not particularly well suited for the purpose; and above all, they are prevented from reburning their own charcoal, and have to send it out to people who make a distinct trade of it. Thus, while in Greenock it costs 3s. 6d. to reburn a ton of charcoal, the same costs in London from 22s. 6d. to 25s., thus inducing the refiner to use less charcoal than he would otherwise be likely to do. The description I shall give of the process of refining will refer to crushed or soft sugar, and chiefly to the Greenock system, the principal peculiarity of which is, that no syrup is produced; all the sugar leaves the refinery, as it came to it, in the solid form, and the loss, consisting of insoluble matter, compounds vegetable and mineral, abstracted by the charcoal, and loss in working, do not amount in all to more than 5 per cent. Whether this system is theoretically a correct one, I am not prepared to say, but at all events, it has been commercially successful; and the precision and rapidity with which the work is done appear to me to place sugar refining at the summit of perfection as a manufacturing process, and one which might, with great advantage, be imitated in many branches of technical chemistry.

Sugar Refining.

In refining raw sugar, it is very important to make a proper selection of the raw material. The qualities are very various, and each kind is adapted for a particular system of refining. In the Greenock system, for example, in which no syrup whatever is turned out, it is absolutely essential to use sugars containing only a moderate amount of uncrystallziable sugar, say not exceeding on the average 3 or 4 per cent.; but where a considerable quantity of syrup is produced, the quality of sugar is of less importance, and low Concrete and low sugar, such as syrup Mauritius, Jaggery, and Manilla may be used. Mixtures are often judicious, such as beet sugar with sorts which contain much fruit sugar, but in the Greenock system a large proportion of beet must be avoided, as the soluble salts accumulate in the lowest kind of the refined product, and communicate an objectionable taste, besides retarding crystallization. In purchasing sugars for refining, several points demand attention. The absolute quantity of cane sugar is important, as determining mainly the proportion of refined capable of being produced; and the fruit sugar and salts, as preventing, to a large extent, the crystallization of the cane sugar, demand attentive consideration. The extractive matter determines chiefly the amount of animal charcoal required, as well as the amount of deterioration of the charcoal. The insoluble matter, when excessive, is troublesome to wash, and some kinds of insoluble matter are difficult to filter, stopping up the pores of the cloth, which the finer particles pass through, and are afterwards deposited in the charcoal, to its great detriment. This is particularly the case with some kinds of East Indian Sugar.

The analysis of sugar is very simple to those who have some practice in this kind of work, and most of our refiners pay great attention to this branch of their business. Many of them have qualified chemists in their refineries, while some employ a professional analyst. I have myself made about 400 analyses of raw sugar, chiefly for refiners in Greenock, and the following table contains a few results of analyses of some of the varieties of raw sugar used by refiners :—

	Cane Sugar.	Fruit Sugar.	Extractive, &c.	Soluble Salts.	Insoluble.	Water	Colour D.S.	Cane Sugar obtainable.
Cuba—Muscovado ..	92·35	3·38	·66	·62	·15	2·84	13	85·9
Grenada ..	92·31	4·06	·66	·37	·04	2·56	13	86·4
Trinidad ..	90·41	3·84	·95	·86	·22	3·72	10	82·3
Demerara ..	90·80	4·11	·77	·92	·20	3·20	10	82·1
St. Vincent.	89·00	5·85	·76	·62	·05	3·72	10	80·
Concrete ..	84·20	8·45	1·70	1·10	..	4·55	12	70·2
Melado	67·00	11·36	1·93	·76	·15	18·80	..	51·8
Molasses ..	47·0	20·4	2·7	2·6	..	27·3	..	13·6
Pernambuco	88·31	4·82	·94	·80	·73	4·40	8	79·5
Paraiba	84·90	6·00	1·28	1·20	1·10	5·52	8	72·9
Bahia	86·80	5·03	1·72	1·21	·92	4·32	7	75·8
Syrup Mauritius	86·00	6·35	1·62	1·44	·23	4·36	8	72·5
Calcutta Date	87·06	6·95	·65	·68	·56	4·10	8	76·7
Jaggery ..	86·73	6·05	1·29	·88	2·01	3·04	6	76·3
Unclayed Manilla..	79·00	11·76	1·32	1·95	·63	5·34	6	57·5
Amoy	74·50	16·13	1·70	1·61	·54	5·52	7	50·4
Formosa ..	76·53	13·38	2·47	1·86	·16	5·60	9	53·8
Maple	72·60	13·95	2·11	1·35	·03	9·96	..	51·9
Fr. beet (fine.) ..	93·80	·15	·87	1·30	..	3·88	13	87·1
Ger. beet (low.) ..	87·80	·33	2·75	3·92	·13	5·97	10	67·9

These analyses must not be considered as typical of the various kinds of sugar, for all of them vary exceedingly; but they give a fair idea of the description of sugars used in refineries where crushed sugar is made. Several of the lower sorts are unfit for refining on the Greenock system.

The French mode of determining the value of raw sugar is, upon the whole, a very fair one, and is based upon two assumptions, namely, 1st, that each percentage of fruit or uncrystallizable sugar prevents the crystallization of an equal amount of cane sugar; and 2nd, that each part of soluble salt prevents the crystallization of five times its weight of cane sugar. My own experiments bear out the general accuracy of these assumptions. To value a sugar, or find the amount of extractable cane sugar in it, we take the total amount of cane sugar, as determined by chemical analysis or the polariscope, and deduct from it the fruit sugar and five times the soluble salts, and the remainder is the quantity required. Thus, take as an example a sample of Paraiba sugar, containing 84·9 cane sugar, 6 of fruit sugar, and 1·2 of soluble salts, the obtainable cane sugar from this variety would be 72·9 per cent.

First Operation, Solution.

The first operation in sugar refining is dissolving, or what is technically called "blowing-up," from the circumstance that open steam was formerly used in the process, producing a violent agitation and blowing noise. Although I do not propose to detail the mechanical arrangements of the sugar refinery, yet I must mention briefly some particulars, in order that the chemistry of the subject may be understood. The different floors of a sugar house, generally six or seven, are arranged so that in the process the sugar passes down from one to the other. Acting upon this principle, the sugar is hoisted to the top storey or garret, where it is removed from the hogsheads, boxes, baskets, or bags in which it is imported, and shovelled through holes in the floor into the blow-ups, which are situated on the floor below. These vessels are cast-iron pans, about 4 or 5 feet high, and from 6 to 10 feet in diameter. At some distance from the bottom, leaving room below for a series of steam pipes, is a false bottom perforated with holes, upon which the sugar rests until it is dissolved, and both above and below this shelf revolving arms are moved by machinery, so as to keep the liquor in constant motion. The operation is commenced by placing in the pan a sufficient quantity of water or thin liquor, turning on the steam to the heating worm, and then filling in the sugar as quickly as it can be knocked out of the casks. If the blow-up is well constructed, the filling should be completed in half an hour, when the gravity of the liquor should be about 28° Baumé (or 1·225 sp. gr.) and the temperature as nearly as possible 180° F. The liquor consists of about two parts raw sugar to one of water, and a pan of 10 feet diameter will dissolve at each filling about seven or eight tons of raw sugar. During the heating a scum rises to the surface, which is skimmed with nearly flat perforated ladles, but the amount of flocculent and insoluble matter so collected is very trifling. Such is the simple process as conducted in most of the Clyde refineries, but elsewhere the liquor undergoes in the blow-up various kinds of treatment, with the object either of removing a part of the colouring matter, of neutralising the trace of acidity in the sugar, or of facilitating the subsequent process of filtration, so as to produce a perfectly clear bright liquor. It is a very common practice to add a sufficient quantity of milk of lime or sucrate of calcium, in such quantity as to neutralize the acidity of the sugar, and although this is not done in some of the best conducted refineries, yet I consider it a useful addition, provided too much lime is not used, for if excess is employed it tends to deepen the colour of the liquor, and to give the charcoal additional work. Again, blood was formerly much used for clarifying, as it coagulates by heat, producing flocculæ, which enclose and carry down fine particles of mud or other insoluble matter. The coagulated albumin also abstracts a small proportion of the colouring matter, for which it has a strong attraction. Instead of blood, the solid albumin obtained by evaporating the white of eggs, or the serum of blood, at a low temperature, has been used, and has the advantage of not being quite so filthy as blood; but all these bodies, which make the syrups very impure, are now generally dispensed with. Various other substances have been used instead of blood, such as a mixture of sulphate of alumina and lime, which forms a gelatinous precipitate of alumina, but is objectionable on account of introducing calcic sulphate, soluble tricalcic phosphate, and soluble phosphate of alumina and lime. The greatest objection to these mixtures is the danger of the common workmen, who are necessarily entrusted with the application of them, using excess of one or other, and so making the liquor acid or alkaline, and thus doing more harm than good. Above all, it does not appear to be absolutely necessary to add anything to the liquor, and many of the first refiners use no chemical agent whatever. For the removal or partial removal of the colour of the sugar, the dust of animal charcoal is sometimes introduced, and if it is quite new, that is, not used in sugar refining previously, it has a good effect. The charcoal can only be used once, however, as it gets mixed up with the insoluble matter of the sugar.

The next operation is a purely mechanical one, and consists in passing the solution of sugar through twilled cotton filter bags of about two feet diameter, crushed into coarse canvas sheaths of about 6 inches in diameter. These bags are 6 or 8 feet long, and are fastened, to the number of 200 or so, to the bottom of a shallow tank, into which the liquor is run from the blow-up pans, and they are surrounded by the sides of an iron box, so that the liquor is kept hot, and also that steam may be introduced to keep up the temperature.

Decolorizing of the Syrup.

The next operation, after having obtained the saccharine solution clear and bright, is to remove the coloring matter, and this is effected by bringing it in contact with animal charcoal, otherwise called bone black. This variety of charcoal has been found by practical experience to be the most suitable for sugar refining. Many kinds have been tried, some of them, as decolorising agents, much more energetic than bone black, but none of them have been found to possess that peculiar combination of qualities which is required—freedom from soluble salts and from considerable quantities of calcic sulphate or carbonate, sufficient density to sink readily in the heaviest sugar-liquor, and at the same time great porosity; together with such a degree of hardness that it will not suffer sensible deterioration by being shovelled about and reburned every fourth day for several years. These qualifications exist in no kind of charcoal in such a marked degree as in that from bones. An artificial mixture of clay and some form of carbon has indeed been made, which is said to rival animal charcoal, but as I have heard nothing of it lately, I fear that it has not been found so advantageous as was expected. The only kind of charcoal I have found at all to approach that from bone, is the kind made from certain kinds of sea-weed, but even this variety is wanting in some of the characters neccessary for refining sugar.

Other decolorizing agents than charcoal have also been proposed. Sulphurous acid has been tried repeatedly, and processes are published every two or three years in which its use is advocated, each writer apparently ignorant of the fact that his results are already well known. At best it only removes about three-fourths of the colouring matter, and the liquor requires to be treated with charcoal just as much as if sulphurous acid had not been used. It is true that sulphurous acid does not alter cane sugar like most other acids, but it is very liable to change into sulphuric acid; and although this may be neutralized with lime, still the calcic sulphate is very injurious to the charcoal which must afterwards be used.

With regard to the bleaching action of ozone, I have made no experiments myself, but I understand that its application has not as yet been practically successful, and even if it were found economical in bleaching the colour, still it would not enable us to dispense altogether with charcoal, and I fear its oxidizing action would be likely to prove troublesome. Upon this point, however, I am not qualified to give an opinion, as I have not had an opportunity of seeing the process in operation.

The carbonatation process, as applied in the continental factories where sugar is made from the juice of the beet, and which is attended with excellent results, has not, so far as I know, been applied on the large scale to the process of refining raw cane-sugar, and I do not think its application would be advantageous. The sugar solution for this process requires to be rather dilute, and consequently would require to be boiled down before passing through the charcoal, for it would not be a substitute for charcoal, but only an adjunct to it. I have made careful trials of the process with dark sugar, and have found little or no benefit from it as regards colour, although it makes the liquor beautifully clear and bright. I think, however, that in certain cases it might be applied with good results, as for instance in purifying the washings of animal charcoal, which are very impure and very troublesome to deal with, and also to bag filter washings and any other impure products of the process of refining. To those who are not acquainted with the carbonatation process, I may describe it very briefly. The sugar, dissolved in a sufficient quantity of water, is mixed with milk of lime, the quantity depending upon the colour of the sugar to be treated, and, after being brought up to a moderate heat, carbonic gas is passed through the liquor until the lime is completely carbonated, after which it is boiled to decompose the calcic bicarbonate; and the precipitate then becomes grainy and settles readily. In the beet factories the process is repeated with a smaller quantity of lime, after which the juice is boiled down to 20° or 25° B., and passed through charcoal.

Impure saccharine products, such as bag-filter and char washings, and low syrups much contaminated with salts, may also be purified by precipitating the sugar as a sucrate of calcium or barium, and afterwards separating the base by carbonic gas, or in the case of baryta, by sulphurous gas. I consider it an excellent arrangement to have connected with every large refinery, a smaller one immediately adjoining it, where all impure products are separately treated and worked up separately from the sugars made in the refinery proper.

As a preparation for the decolorizing process, it has been proposed to wash or digest the raw sugar with alcohol before dissolving in water, and this idea has been tried on the large scale in Belgium, but has been discontinued. Theoretically the treatment of raw sugar with alcohol appears to be highly advantageous. The quantity of cane sugar in a pure form obtainable from raw sugar is very much reduced by the presence of soluble salts and fruit-sugar, the former preventing the crystallization of five times its weight, and the latter of an equal weight of cane sugar. By the use of alcohol together with a minute quantity of hydrochloric or acetic acid to act upon the calcic salts present, the whole of the impurities, with the exception of some of the colouring matter, may be removed, and nearly pure cane sugar obtained. But in practice there are serious difficulties to be overcome. A very pure and nearly absolute alcohol must be used, and the expense of maintaining this would be considerable, and the inflammable nature of the spirit is a serious objection; but under any circumstances it would be quite out of the question unless the spirit were obtained free of duty. A moderate sized sugar house would require something like 10,000 gallons of spirit to start with, and the duty on this alone would be about as many pounds sterling, and as this quantity would require to be redistilled every day there would be a considerable and unavoidable loss. The process has long been used for testing raw sugar, and most successfully, but the possibility of its successful application on the large scale has yet to be demonstrated.

(To be continued.)

THE SUGAR INDUSTRY OF JAVA.

By J. Millard, Esq.

(*Continued from page* 223.)

From the central factories [of the French Antilles] constructed on a large scale, important results are expected. The object of them is to work up the cane from several plantations, the planters receiving 5 per cent. of the yield in sugar. The undertakings are joint stock companies, the shares of which are already at considerable premiums.

Nevertheless if the process of manufacture has progressed agriculture is still very far behindhand, and the lack of laborers affords reason to fear that the latter will not be able to keep pace with the former. Much has still to be done to raise the production to a degree approaching that of Java, for hitherto the results have not been very important.

The solution of a great social question: labour without slaves, has not yet been effected either in the French or in the English colonies.

In Jamaica the culture of sugar has, after many fruitless struggles, succumbed to the consequences of emancipation. In general, the sugar industry in the British colonies is oppressed by the legislation of the mother country, which, for the protection of the numerous sugar refiners, prevents the production of fine, beautiful, white sugars, and consequently renders the application of what science teaches, useless, so that some of the sugars made there, are of so low a quality as to be declared by a board of judges unfit for human consumption. The lesson given by such men as Péligot, Dupuy, &c., that the whiter and purer the sugar, the greater quantity will be obtained, has been quite neglected.*

Only Barbadoes, being thickly peopled on a limited territory, in consequence of which the supply of labor is plentiful; and the small island of Mauritius, by means of a well managed plan of immigration, supported by abundant capital, have been able to surmount the difficulties; and besides, the island last mentioned finds an important market for its produce in Bombay, Persia, and Australia, especially the latter.

The rest of the English colonies, encumbered by legislation, have no other outlet for their sugars than to England, and their production is easily ascertained from the imports into that kingdom. A few statistical notices, so far as they have come within my reach are appended to this report and will give an idea of the production in the colonies of foreign countries.

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* The "mother country" does not prevent the production of fine sugars, but merely levies one and the same duty on pure sugar; thus whether 1lb. of sugar enters the country in the form of loaf or blended with 2, 4, 6, or 8oz. of other matter, each pound of sugar pays the same duty, viz., about 1¼d. The Dutch Government levies duties on sugar on the same principle (see No. 4 of "*The Sugar Cane,*" page 238). If it were correct that the whiter and purer the sugar the greater the quantity obtained, the discriminating duties would be of little consequence to the planter.—*Ed. S. C.*

From what has been said above, the deduction may be made, that in respect of productive power, Java, in itself, has nothing to fear from the competition of foreign colonies—a conviction that becomes the stronger, if, without exaggeration, we reckon how, under favourable circumstances, with careful planting and improved machinery, the sugar producing power of Java is capable of larger development.

Various experiments in Java have given the following results per bouw:—

1,800 to 2,400 bundles of cane.
35,000 to 55,000 kilos. of cane. (20 to 30 tons to the acre.)
28,000 to 41,000 litres of juice (5,500 to 9,000 gals.)
10° to 12° Baumé, equivalent to full 19 to 23½ per cent. sugar, and 70 to 74 per cent. of juice from the cane.

Under tolerably favorable circumstances; good cultivation, which enhances the saccharine richness, with sufficient expression and purification of the juice, and good manufacture, it will be far from an overestimate to reckon upon—

10° Baumé.
2,200 Bundles of cane.
45,000 kilos. of cane. (25 tons to the acre.)
75 per cent. of juice or 33,750 litres (7,430 gals.)

The standard of 10° Baumé represents 19·35 per cent. of pure sugar.

The beet root, at the highest contains 10 per cent., of which with a middling crop 5½ per cent., and with a favorable crop 8 per cent. is obtained. The sugar cane may contain 18 to 24 per cent., so that an average of 19 per cent. may indeed be considered as moderate.

This is not the place to decide the contest between scientific men, whether or not, originally, uncrystallizable sugar is found in the fresh cane juice. So much is certain, that with the best means of preparation, such sugar and foreign substances are found. On account of defect in defecation and filtration it is, at present, tolerably noticeable in Java; and a close examination has brought to light $\frac{1}{10}$th or $\frac{1}{8}$th, reducing by 2 to 2½ per cent. its saccharine richness.

If, therefore, with an efficient manner of working, 4 to 5 per cent. is allowed for it, and thus the saccharine substance proper, reduced to 15 per cent. instead of 19·35 per cent., it is more than probable that such a return may be generally obtained.

The following results then have been arrived at:—

33,750 litres 15 per cent. = 5,062 kilos. or nearly 82 picols of pure white sugar per bouw (56½ cwts. per acre) reckoned on the 70,000 acres of sugar cane plantation in Java, a production of about 197,700 tons; whereas, in the last five years, on an average, 103,000 tons has been obtained; possible increase of the crop, 94,700 tons; representing an enhanced value of at least twenty three millions and a half guilders.

That this improvement is not chimerical, is shown by the crops of the sugar-producing countries. The well-known Reynoso* also assures us that as soon as the cane fields are managed as they ought to be, the average yield of a caballeria (33⅓ acres) will be at least nearly *one hundred thousand kilogrammes* (nearly 3 tons per acre); and most probably, much more, and that a time will come which fortunately, as he thinks, is not very far off, when such a surface will produce cane enough to yield 200,000 to 250,000 kilogrammes of sugar (from 6 to 7½ tons per acre).

It is not necessary to refer to Cuba and other colonies to show the prospect or the probability of a production of a million and half picols (90,000 tons) more in Java, for in support of that calculation a striking instance may be cited from Java itself, namely, the production of Kidawoeny, where there was obtained from 202½ bouws (354 acres), 449,790 bundles of cane of 0·464 picols each, on an average 2,227 bundles of cane per bouw, or 64,046 kilogrammes per bouw (about 36 tons of cane per acre); from which were obtained 7,970,400 litres of juice of 9·83° Baumé, or 39,408 litres per bouw (4,900 gallons per acre), or about 61 per cent. of juice; 19,286·63 picols of sugar, or 95·24 picols per bouw (3¼ tons of sugar per acre), or 15 per cent. of sugar, precisely agreeing with my calculations.

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* Reynoso: "Treatise on the Cultivation of the Sugar Cane."

The expression (at 61 per cent.) is not very unsatisfactory; for if it had reached 75 per cent. the production would have risen to 116 picols per bouw (4 tons per acre). It is evident that excellent cultivation and equally good manufacture are essential conditions of reaching this figure.

The opportunity seems to me convenient to refute the reproach indirectly cast upon the sugar manufacturers Java by the calculations of the writer of the article *Suiker*, in the "Aardrijkskundig en Statistisch Woordenboek van Nederl. Indie," in which he comes to the conclusion that the production of 78 manufactories, amounting to 1,371,643 picols, from 32,658 bouw or 42 picols per bouw (29 cwts per acre), with an average richness of juice of 8·53. Baumé would show a loss of 765,237 or 23·43 picols per bouw (18 cwts to the acre), and only 64 per cent. would have been produced.

Apart from the consideration that in the figures to which the writer had access no confidence whatever is to be placed, his conclusion is incorrect. First, because the hydrometer of Baumé cannot indicate exactly the richness of the crystallizable sugar in the saccharine juice, since the juice is mixed with foreign matters; salts, protein substances, etc., which influence the density, and the greater number of saccharine fluids do not contain pure solutions of sugar, so that to confine myself to one example, 6° or 8° Baumé may contain more parts of sugar than a higher degree. Baumé's areometer can be of use only in controlling the degree of concentration. It is chiefly by means of the polarizing apparatus, based on an optical effect of the rays of light on the fluids, made known and applied to saccharine solutions by the celebrated Biot, that a more perfect knowledge of the saccharine richness is acquired.

It is certain that the juice of the sugar cane possesses an important advantage over that of the beet-root, by containing much fewer salts that hinder the formation of the crystallizable sugar. But yet, if in practice a result quite different is arrived at, not only must that be taken into account, but also the inevitable loss by evaporation, by the boiling over of the syrups, and, using the same figures as the writer mentioned, from the given quantity of juice might be obtained 1,445,533 picols, or 44·36 picols per bouw, (30 cwts. per acre) showing a loss of only 73,910, or per bouw 2·26, or about 5 per cent. of crystallizable sugar. If it be taken into consideration that the beet-root manufacturers commonly obtain 72 per cent., then, if the figures could be relied on, the Javanese manufacturers, in all respects, deserve commendation. If there are any who reproach the manufacturers in Java with not being skilful in their business, more weight ought to be attached to the opinion of a good judge, already mentioned by me, a scientific man, who, has for a long time paid diligent attention to the sugar industry, and who states that the contractors are well up to their business, but limited in their means from want of durability in their contracts, and the high exactions of the Government, by which, in addition to their social positions, they are rendered unable to apply the results of science.

I have before alluded to the substances drawn from the ground by the sugar cane, the restoration of which is prevented by the conditions under which the land is held.

I allude to it chiefly that I may notice the privilege that is possessed in Java of changing the cane patches; without bringing into question the use and necessity of manuring, but entertaining the opinion that in cultivation, not only chemical, but also physical effects must be attended to, and convinced by experience of the advantage of the rotation of crops, I think that privilege invaluable.

Nevertheless, the problem has not been solved by all. Thus we read, in the papers exchanged on the scheme of the law concerning cultivation (*Outwerp Kultuur wet*) that the Council of State was of opinion that, starting from the opinion that changing of cane patches would be unnecessary, it would not be impossible to persuade the contractors to an arrangement, by which there should be made over to each of them an extent of 600 bouws (1000 acres). The Government considers the plan inadmissable, because by it a way of cultivation very different from that till now followed was aimed at;

the rotation of crops is superseded by retaining the roots—*i.e.*, ratooning—or by additional planting on the same estate—a plan for the present not to be realised, even if we are willing to assume that in future it may be capable of application, when means shall have been found of restoring to the ground what has been drawn from it by the cane. According to the Committee of Inquiry, the only result of the proposed system on well-managed plantations is a smaller yield than is obtained by the changing of the cane patches. Whether manure would give different results has not been proved experimentally, as yet, in Java.

So long as the present system is maintained, and so long as, for the most part, ample opportunity for that changing exists, the question would perhaps be of less immediate importance; but as soon as private undertakings on private land are spoken of, or even on that of the Javanese husbandmen, which affords no opportunity for changing, the question is of eminent importance, even from a pecuniary point of view, because the outlay of capital is thereby determined.

The solution of this problem, in my opinion, well deserves consideration, and therefore I most readily submit my views on it to the decision of judges.

Meanwhile, the privilege I have alluded to has attracted the attention of foreign countries. On the occasion of a comparison between the yield of Java and that of La Réunion, the advantage of the island first mentioned, was ascribed to the system of changing of cane patches, which after the harvest are burned off, and thus freed from hurtful insects, particularly the Borer Saccharellus, so that the planters of La Réunion are recommended to grow the sugar cane on only one-fourth of their fields, allowing the rest to lie fallow for two years at least.

The Committee of Inquiry I have just mentioned put the question to the different authorities—" Were it not desirable to substitute for that system the granting of inalienable lands?"

Although not quite in harmony with the intention of the Commission, that question was understood by many in the sense of uninterrupted growth on the same land. In general many objections have been raised against it. The results of trials made, had, according to their accounts, been below mediocrity; at the highest the average production could be estimated at 20 piculs per bouw (14 cwts. per acre). The continuance of more cane crops on the same fields would require more labour and greater expense than the laying out of new gardens; sufficient manure could with difficulty be obtained, and fear would be excited of a general exhaustion of the land, so that the native chiefs declared themselves in general against the plan.

Against this might have been urged, not without reason, that the lack of agricultural knowledge and defective treatment have led to wrong conclusions, and the native chiefs are interested in that constant changing, because it affords them the opportunity of getting possession of the best lands for their own cultivation.

To form a correct judgment, it is then necessary also, to examine the results obtained in Java and elsewhere from an uninterrupted growth of the sugar cane on the same fields, and to consider the arguments which, pleading for and against it, agree with experience and the lessons derived from agriculture and chemistry.

I may not allow myself, at present, to enlarge on what science teaches; but a few concise, simple rules will not be placed amiss here.

The advocates of the changing of lands urge that plants of similar sorts cannot thrive on the same land during successive years, and those lands at length become unfruitful, and must lie fallow to collect new strength. Fallowing, however, is the infancy of agriculture, and wastes the capital of the land.

Science points to the rotation of crops instead, based on these principles :—

First: That every plant draws a certain quantity of mineral substances from the land.

Second: That every plant does not withdraw the same sorts of substances, or in equal degree.

Third: That each plant favours the growth of weeds in a different manner.

The consequence of the application of these principles is—that the plants which are grown for the use of their seeds (wheat, barley, oats, &c.) ought to be rotated with plants, whose roots, leaves, or bark is desired, and that intervals as long as possible ought to precede the growth of the same crop.

The substances, which one crop, by the co-operation of chemical and physical agencies, renders soluble, yet does not absorb or require, are left in the ground for the benefit of other plants. Therefore, a good rotation of crops is based on a correct knowledge of the constituents of the different plants and their requirements.

In support of our views, we cite a passage from Cameron's *Chemistry of Agriculture*:—"The employing of the land to produce other crops, while it is being replenished by nature for the production of that which had previously exhausted it, is an important step in the progress of scientific agriculture."

"Indeed, so far is it from impeding the progress of amelioration just mentioned, that we have reason to believe that the *mechanical* operations attendant upon the raising of the *intermediate* crops facilitate this process materially. The breaking up of the super and sub-soils, and exposing them to the air, promotes this end."

Manuring alone is not sufficient, but is, though, in the long run indispensable, because the soil requires the addition of substances which may, indeed, be present in it, but are not always in a soluble state. Rotation of crops thus saves the substances necessary for succeeding plants; manure adds to them what might be wanting. It must form the *humus*, or repair the loss of it, unavoidable even in the rotation of crops, either by substances artificially brought together, or by ploughing in crops fit for that purpose; but it cannot in the long run make good the loss of mineral substances. It cannot give the rest which the soil, wearied by spending its strength uninterruptedly on one crop, so much needs.

Experience has confirmed that opinion. In Virginia, many lands of apparently inexhaustable richness have at length become quite barren by the uninterrupted growth of tobacco, on which rotation has been neglected, but without manuring also. Different lands in the district of New York, worked in the same way, yield at present scarcely a fourth of their former crops, and in general the consequences of that exhaustion are felt in America.

The natural richness of the land offers a seduction which has, at the expense of the future, often caused the voice of science to be disregarded. Even in Australia this neglect is felt. The Consul of the Netherlands, alluding to it, says in his report:—"It is thought that the neglect of proper manuring, as well as the uninterrupted sowing of the land with one and the same sort of grain is the cause of it (bad growth and mildew). The husbandmen are therefore most strongly recommended, by means of the different agricultural societies, to bring about a change in their cultivation." *

What husbandman in Europe ever thinks of always growing the same crop on the same land? He would resemble a spendthrift, who not only does not put by any of the interest, but spends his capital recklessly.

In the cultivation of the beet-root the same has been experienced, and the manufacturers in the Departement du Nord, where the beet-root has been grown ten years successively on the same land, are warningly directed by the celebrated economist, Mauny de Mornay,† to the consequences of that exhaustion, and the instances have consequently not been wanting of how the infringement of one of the first principles of agriculture makes itself felt.

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* Report of the Consul-General (Netherlands), to be found in the *Netherlandsche Staats Courant* of 24th August, 1865.

† On this subject, "Le Livre du Cultivateur, par M. Maunay de Mornay," "Guide Pratique du Fabricant de Sucre, par N. Bassett," may be consulted.

Du Rieux, a respected agriculturist, declares that a rotation of three years at least is necessary for the growth of the beet-root, even with proper manuring; and that, with few exceptions, wherever the soil has not been allowed that rest, the yield of the beet-root cultivation has declined considerably; among others, in the district of Valenciennes, from 40,000 or 50,000 kilogrammes to 20,000 or 25,000 kilogrammes per hectare (from 15 or 20 to 8 or 10 tons per acre).

This way of acting is somewhere termed, with justice, a plague to agriculture; and there is no writer of knowledge and experience who does not most strongly recommend rotation (of at least three years, better still of from four to six years), attended with manuring; so that, consequently, it will in few places be longer neglected.

This view of the case has become so prevalent that the *Journal des Fabricants de Sucre* (October 10, 1867), says:—

"The too frequent repetition of the beet-root on the same soil is one of those agricultural errors which does not deserve to be combated scientifically. The universal results of this method, to which we may give the name of the vampire culture, are such as no judicious spirit can approve. Such industrial agriculture as is pleased to sow the beet three or four years in succession on the same land, ends by exhausting the soil by the inconsiderate abuse of this culture, which belies the law of rotation of crops and that of restitution."

With this question about rotation, what has lately been written by M. Fries ("Economist") may well be taken into consideration:—

"That the yearly alternation of the crops cultivated in the field is an absolute necessity of nature has been long accepted as a matter of fact, which every farmer provides for by the rotation of crops.

"But since the aim of sugar manufacturers has been more and more to get rid of other produce to make room for the cultivation of more beet, this universal axiom has been discarded, and the beet has often been grown continuously. It was scarcely thought that this system would be successful, so some means of counteracting nature were sought. Thus, when the yield of the beet decreased, it was properly considered as a laxness of growth, for which reason this disease of the beet was called '*Rubenmudigkeit*'—root exhaustion. It was, indeed, believed that the disease could be removed by such combinations of manure as should richly restore to the soil those elements which the beet draws from it. *Up to the present time this aim has not been effected.*"

Probably reference has been made to the difference in fertility between the temperate and the tropical countries. It is certain that in the tropics nature is luxuriant and generous; but even there the limits of her powers are not transgressed with impunity.

"Uninterrupted planting of cane on the same land," said a naturalist, Mr. Fromberg, many years ago, "even with manuring, causes the cane to degenerate; even with irrigation and a yearly alternation with paddy this cannot be prevented."

The observations of Mr. Krajinbrink, one of the best-informed land-owners in Java, are well founded, with regard to the culture of rice in connection with the growth of sugar in Java.

"One fact standing alone," he says, "which has often led to quite wrong conclusions, exists here in Java, where rice is grown on the irrigated sawahs. Every one knows that the sawahs are planted anew every year with paddy, sometimes even with second or summer crops, and that the native never manures; and yet it is observed everywhere that the irrigated sawahs gradually increase in fertility and value, that the oldest irrigated sawahs are constantly considered the best, and that newly-cleared sawahs, from the peculiar working of the ground, to make pettaks of them, at first sometimes quite barren, after a few years yield as rich harvests as the older fields lying next them."

"The cause of this paradox is nevertheless obvious. In a paddy-field only the ears are cut off; the straw remains upon the field, and is trodden into and mixed with the ground by the buffaloes. Thus, such a paddy-field gets a rich supply of humus-forming substances every year, which the plant for the most part has prepared from the carbonic acid of the atmosphere; and the mineral constituents, which are taken away in the ears of the grain, are insignificant in comparison with those which are left behind in the straw. But, moreover, by the yearly irrigation a considerable quantity of floating slime and salts, and silicates in solution, are conveyed to the field, which far exceeds the substances taken away in the ears and grain. Also, in this way the sawah gains more nourishment every year than it loses, and in the mineral part the richness is increased also.

"It follows, of course, from this, that the planting with sugar cane on behalf of the Government contractors, if it be done only once in five years on the same land, and then for four successive years paddy is planted, cannot produce any observable exhaustion of the soil. What is given back to the land in those four years will exceed what has been taken from it, and experience teaches it, for, generally speaking, the production of sugar during the last thirty years has not decreased, but rather increased, and where a decrease has existed, the cause of that decrease can by close examination be shown. Besides, all the leaves of the sugar cane and the roots remain on the ground, the former for one part as humus-forming, and for another part as ash-constituents, when burned.

"Thus, for the cultivation of sugar by the Government by this means, and following the existing arrangements, no impoverishment of the land is to be feared, but so much the more on those lands on which this plant is cultivated every year, and particularly with the continuance of ratoons.*

(To be continued.)

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* "The Future of the Private Cultivation of Sugar," by J. A. Krajinbrink; "Journal of Manufacture and Agriculture, in Dutch India," vol. ix. p. 407.

On the next page is a table adapted from one in the appendix to Mr. Millard's work.

Imports of Colonial Sugar into the United Kingdom from the Various Foreign Sugar-Producing Countries & Colonies, from 1845 to 1867.

	1845.	1846.	1847.	1848.	1849	1850.	1851.	1852.	1853.	1854.	1855.	1856.	1857.	1858.	1859.	1860.	1861.	1862.	1863.	1864.	1865.	1866.	1867.
	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.	Tons.
Cuba	9874	25655	45727	36742	35006	26909	41510	23307	48548	83255	36583	37517	50724	83289	83556	70254	103136	107767	106739	147467	110806	83689	143161
Porto Rico	7553	4824	12424	8416	12092	8998	14994	2628	7171	18921	11963	9981	9853	18182	10845	13135	25932	21926	27272	22611	13524	8372	12253
Guadaloupo	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	1006	....	....	100	....
Martinique	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	18	....	....	....
St. Martin........	....	....	....	....	11	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
St. Eustatius	160	....	113	....	....	....	16	....	....	46	....	141	....	....	....	....	....	....	....	....	....	....	....
St. Croix	....	8	3622	2692	2311	377	437	418	69	1358	112	209	141	1122	124	....	145	84	.. .	....	....	236	....
St. Thomas	....	....	....	....	308	....	....	....	....	33	36	1	....	472	....	63	3	2	1	1	10	205	19
St. John..........	....	....	36	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....	....
Dutch Guayana ..	82	75	....	....	6	223	221	83	1412	1406	1976	1742	2404	2012	8062	3015	4261	4939	3773	2345	2409	2478	3130
United States	1112	10	22	84	376	330	234	40	1383	3413	763	1125	13211	1487	2286	358	13198	83	20	12587	415	245	2911
Central America..	....	....	....	....	....	....	....	....	....	....	....	....	47	296	372	714	420	1174	1522	2050	905	529	1825
New Granada ..	..	98	53	228	73	4	4	2	....	....	....	....	....	....	....	....	3	....	9	248	....	7	210
Venezuela	344	580	243	250	438	213	72	....	....	58	4	3	....	....	....	....	....	....	....	....	....	7	14
Brazil............	16268	15103	35084	32689	28187	18134	36022	14000	33560	28966	23434	26560	42547	41812	55930	21649	37589	63150	59571	59490	50979	66665	54732
Chili	....	....	1	....	1	....	....	....	1	....	....	....	....	1	....	....	....	....	....	....	....	....	170
Peru	....	....	2	....	....	....	....	....	....	....	....	....	....	....	....	7	145	....	....	535	118	....	....
East Coast Africa .	29	....	56	....	32	....	....	42	....	....	....	....	....	....	....	....	....	....	....	49	285	28	86
Rennion..........	....	....	....	....	....	....	....	....	....	231	....	....	....	....	....	366	303	....	....	....	....	278	....
Siam	8	....	897	....	....	426	....	....	....	....	....	....	1515	835	2810	2340	624	978	442	....	91	21	....
Java	2344	4046	9711	3460	3618	2922	2806	940	1478	6623	3698	434	1607	680	6238	7937	5234	2688	328	....	....	285	113
Phillippine Islands	5929	3656	8692	7175	4385	7226	11011	3810	2403	17555	15971	19040	10930	12889	18203	19090	25687	17271	41576	17924	29696	26228	17313
China	288	2911	4451	1804	....	30	1	2806	....	1	....	918	3087	597	46	1834	402	377	530	1	1	....	1

ON THE USE OF LIME AND CARBONIC ACID IN SUGAR REFINERIES.

By M. Eug. Feltz, Smela, Kieff, Russia.

From "La Sucrerie Indigene."

Since the introduction of lime into the process of manufacture, many attempts have been made to realize, by the aid of this agent, a complete purification of the juice and syrups. Starting from the principle that lime, and the organic matters which spoil the juice and syrups, form under certain conditions of temperature insoluble compounds, the inventors have all naturally sought to augment as far as possible the quantity of lime used, in order to obtain a purification so much the more complete. When we pass under review the various processes which have succeeded each other in our sugar manufactories, or which are still disputing the victory, we are struck by observing that the dominant idea of all these processes is the same: each inventor has striven to employ larger quantities of lime than his predecessors. The ulterior elimination of the excess of lime retained in solution by the sugar, alone appears to prevent the indefinite increase of the quantity, and we may thus almost say that the greatest improvements have been directed towards the mode of eliminating the active agent of defecation.

Carbonic acid, more or less pure, is, up to the present time, almost exclusively employed with this aim. It can be produced very economically in the manufactories, and in the conditions under which it is used does not exercise any injurious action on the sugar. Barruel recommended its employment some time ago; but it is to M. Rosseau that the honour belongs of having introduced it into practical use.

After some years, the Rosseau process (which is merely defecation by large doses of lime, and subsequent elimination of the excess of this reagent) seems likely to be superseded by what are called the new methods. The distinctive character of these processes, known in Germany as the Zelinck processes, and patented in France by MM. Porier-Possoz, consists in the simultaneous use of lime and of carbonic acid to produce the purification of the juice and syrups. These methods are a real improvement when they are properly carried out. Unfortunately, the promoters of the combined action of lime and carbonic acid have allowed themselves to be beguiled, in consequence of the theory of nascent carbonates, into the practice of using considerable masses of lime, which needlessly complicate the manufacture, and are the cause of the diminution of the returns which has resulted in all the manufactories which have substituted the new for the Rosseau process.

For long past it has been sought to extend the beneficial action of lime to the various products of the manufactory and refinery. M. Rosseau at first, and afterwards MM. Perier-Possoz, have applied to the refining of raw sugars their methods of defecation.

M. Rosseau's treatment of syrups is only a new defecation designed to precipitate the matters which, in consequence of their dilution, have escaped the first.

According to MM. Perier-Possoz, the purification is produced by carbonate of lime in large quantities and in the nascent state, and which, in proportion 'as it is produced, absorbs and combines with itself, not only the free organic matters, but also the combinations of lime with these matters. This theory leads to the formal tion in the syrups of the largest possible quantity of carbonate of lime.

When a juice containing large proportions of lime is impregnated with gas, a gelatinous precipitate is produced, which hinders the progress of the operation; this inconvenience has been remedied by adding the lime in a continuous stream, regulated so as to transform it into carbonate little by little as it is introduced into the sugar liquid.

These gentlemen have thus succeeded in impregnating with gas up to 12 kilos. of lime to 100 of sugar. Why, then, is this process only partially employed? We have shown elsewhere the dangers attendant on the use of large quantities of lime in working the juice; these dangers increase with the richness of the juice or syrups, and every prudent manufacturer hesitates to employ a process which, from the carelessness of the workman or the overlooker, may cause a considerable loss of sugar. This process is in other respects completely impracticable; the dregs which it produces require to be washed with very considerable quantities of water, and however inferior in quality the raw sugars may be, it would be absurd to melt them with this liquid.

Is it needful to conclude from the preceding observations that lime and carbonic acid can render no service in refineries? No, for we are now about to examine another process, which in appearance is not original, and which in reality shows us a mode of usefully applying to refining the two agents which render so much service in the manufacture.

The inventor having been so generous as to give up his patent rights for the public benefit, we can now enter into details which the fear of injuring his interests had prevented our doing. We propose to speak of the Woestyn process.

The clarification and decoloration of the syrups are the two principal operations of present refining, the purification by osmose not having yet taken the place in our réfineries which it appears destined to do. The clarification is usually made with a mixture of blood and charcoal dust, which is added to the syrups at a temperature of 95° to 105° Fahr.; being then raised to the boiling point, the albumen of the blood coagulates and unites with the organic impurities, and, thanks to the animal charcoal, is easily precipitated. The syrup is then removed from the clarifying copper into fine charcoal filters of different sorts which retain the mixture of char and coagulated albumen, and allow the clarified syrup to flow out; a filtration through granulated char then decolors and renders it fit for the pan.

The use of blood is attended by numerous inconveniences. In the first place it contains salts and colouring matters, which add to the impurities of the syrup; but still more, it is usually a focus for infection detrimental to the health of the workmen. These disadvantages are so well known that endeavours have been made to render the blood inoffensive by drying it, and to replace it by other substances rich in albumen. Our most beautiful boiled syrups sometimes derive from the blood an odour which is retained even by the refined sugar. In Russia, where the consumers of tea are almost the only buyers of sugar, the taste and smell are the great difficulties of the manufacturer. Tho Russian tea drinker, or rather tea taster, discovers an odour from the blood which completely escapes a Frenchman. A large parcel of sugar from the celebrated refinery of Count Bobrinsky has been known to be refused on this account.

Struck by the disadvantages of the ordinary methods of clarification, M. Woestyn has endeavoured to substitute for the action of the blood another reaction; he has given the preference to the simultaneous use of lime and carbonic acid.

The persuasion that MASSES of lime are necessary to produce effects by the aid of these two reagents is so common, that it may not be useless to consider a little more closely the manner in which the reactions to which the sugar industry owes some degree of progress are effected.

When we examine the sediment proceeding from the "Carbonatation process," we always find a notable quantity of lime not combined with the carbonic acid in proportions necessary to form neutral carbonate of lime. According to the theory of nascent carbonate of lime, this lime ought to combine with the organic matters; indeed, it is by this combination that the nascent carbonate acts in purifying the juice. Some analyses of sediments having convinced us that the quantity of caustic lime they contain is not in proportion to the amount of organic matters precipitated, but, on the contrary, to the amount of lime introduced into the juice, we have endeavoured to clear up the difficulty by studying tho action of carbonic acid on solutions of pure sugar, impregnated more or less with lime.

The ends we had in view led us to employ solutions of 10 grammes of sugar per décilitre, and from 4 to 15 grammes of lime per litre, in order not to go too far beyond the ordinary conditions of manufacture. In treating such a solution—containing 4 grammes of lime per litre—with carbonic acid, it is found that a larger quantity of lime is precipitated than is necessary to form the neutral carbonate. For instance—in treating a litre of this solution with ·833 gr. CO_2, there is precipitated 1·644 gr. instead of the 1·337 gr. [? 1·059 gr.] necessary to form the neutral carbonate of lime. This excess of lime disappears, and is gradually formed into neutral carbonate on the addition of a further quantity of the gas.

With a solution of 13 grammes of lime an entirely different phenomenon is produced. The carbonic acid introduced produces on the surface of the liquid a white flaky substance, which redissolves on agitation. A litre of this solution will thus absorb 2·562 gr. of carbonic acid without any precipitation, although carbonate of lime is very nearly insoluble in the same liquid.

As the introduction of gas is continued, a more and more abundant precipitate is formed, containing not only the quantity of lime which the gas should have precipitated, but a considerable quantity in excess. The gelatinous precipitate thus produced quickly disappears under the action of a sufficient quantity of gas.

A solution containing 6 grammes of lime per litre still better illustrates this phenomenon. In a litre of this solution we may introduce ·549 gr. CO_2 without producing any change. A further quantity of carbonic acid produces precipitation, but the quantity of lime precipitated is very far from proportionate to the carbonic acid. Thus, 1·493 gr. CO_2, instead of precipitating 1·900 gr. of CaO, only precipitated 1·096 gr. In proportion as the volume of gas introduced is augmented, the precipitate becomes more abundant, and very soon the quantity of lime precipitated passes the proportions corresponding to the carbonic acid. Thus, 3·142 gr. CO_2, instead of precipitating 3·999° gr. of lime, have precipitated 5·466 gr.

These experiments may be repeated, and it will be found that the same elimination of an excess of lime will take place in raw juice as in juice already defecated. We have been readily convinced that very small quantities of lime, dissolved in cold juice, and gasified at a comparatively low temperature, produce the same purification as masses of lime improperly transformed into carbonate.

We think that it is this excess of lime which always accompanies the precipitation of the lime by carbonic acid in saccharine solutions which forms with the organic substances of the juice the real gummy deposit.

In treating the same juice with variable quantities of lime, and in effecting the "carbonatation," we have found that at the end of the reaction the sediment contained very nearly a quarter of the lime introduced, in a caustic state, or rather, not combined with the acid in the necessary proportions to form the neutral carbonate. The quantity of organic matters eliminated remained nearly stationary after the lime had been added in the proportion of ·75 per cent. of the juice used in our experiments.

In looking at the question from this point of view, we are led to very different conclusions from those which other inventors have arrived at, not less logically, from the theory which served as the base of their operations. Seeing that purification of juice charged with albuminous matters is effected by four thousandths of lime, we shall naturally diminish the quantity employed in proportion as the solutions are more pure, and we shall be able to show the effects of clarification with very small proportions of lime.

In the Woestyn process, for example, the clarification of a concentrated syrup is effected with less than one thousandth part of lime. For inforior syrups this quantity is increased, but is always under half per cent.

The syrups clarified by the Woestyn process—that is to say, without the use of blood—are distinguished by a facility of filtration, and by a very characteristic clearness. Every refiner knows that in his daily practice he is obliged to take account of the different physical properties of the syrups derived from different sources, which analysis is at present incapable of determining. It is thus that certain sugars, more or less deteriorated, imperatively demand in the first place a washing in the turbine; if melted without, the *fine* charcoal filters are easily choked by them, and sometimes become completely useless. The clarification by blood is powerless to contend against this fatal tendency; it is sufficient, on the contrary, to increase the proportion of lime in the carbonic clarification to get rid of all these inconveniences. We think that the carbonic clarification will, sooner or later, everywhere supersede the clarification by blood.

The decolorizing of the syrups is not of less importance than their clarification, because on the former the fineness of the loaves in great part depends. Up to the present time this decoloration has been effected by animal charcoal, which produces at the same time a partial saline purification. The possibility of producing a more complete purification by osmose, which has no decoloring power on the syrup, suggests the idea of superseding the charcoal by some other decoloring agent. In closely observing the varieties of colour which are produced in the process of refining, from the melting of the scarcely yellow sugar to the boiling of the black molasses, it is easy to see that the refiner does not aim at concentrating the colouring matter further than he concentrates in the molasses the uncrystallizable sugar contained in the raw sugars.

M. Woestyn has especially occupied himself with this question, and the conclusions to which he has arrived have gradually been adopted by the sugar manufacturers, and several machinists have endeavoured to construct apparatus based on his ideas.

Whenever syrups are heated, a quantity more or less of caramel is produced. When syrups holding solid matter in suspension are heated, the coloration becomes very marked on the cessation of the stirring which prevents the formation of deposit. But the greatest coloration is produced in our coppers when, towards the end of the operation, the mass of sugar is with difficulty detached from the serpentines, heated sometimes to 284° Faht. When we heat our sugars in a stove, to ascertain the proportion of water, we find that when the heat passes 250° Faht. a considerable coloration is produced. Analogous effects are evidently produced in our manufacture, if we employ steam at too high a temperature. In proportion as the syrups become concentrated, the greater the alteration produced; thus, in the multiple effect apparatus, the greatest heat is always applied when the syrups are the most liquid. It is astonishing to find the same inventors who have so logically constructed this apparatus, acting in an entirely contrary manner in the concentration of the syrups. The same syrup which we have concentrated to 25° or 30° Baumé, with steam at 215° Fahrt., we submit to a heat of 280 or 300, instead of heating with the last steam of the double or triple effect.

The numerous essays of M. Woestyn, of which the conclusions have been deemed sufficiently important and remarkable by the learned editor of the *Jahres Bericht* to be reproduced in the published volume of last year, so much the more strike the intelligent manufacturers, as they are easy to carry out in practice. We have often insisted on the necessity of each of us making our own experiments, as they teach us more than all theories. When we consider that the steam of *one* atmosphere has a temperature of 212° Fahrt., whilst in the same barometric conditions the steam of *five* atmospheres has a temperature of 305° Faht., and to obtain white sugar, it is needful to strive as much as possible against the coloration due to the process of manufacture, we see how important it is to avoid employing steam at too high a pressure. Not to abate the work done, it will be better to increase the heating surface. Very often a single boiling will spoil the decolorizing effect of a good filtration.

When the quantity of lime used in the Woestyn clarification is increased, a decoloration is observed, the more considerable as the proportion of lime is greater. To the refiner himself it must be left to vary the amount of lime, which for sugars above "bonne quatrienne" should not properly exceed 1 or 1·5 per cent. The treating of the sediment does not in any case permit our exceeding 2 or 3 per cent., whatever may be the decoloring effect of a more considerable quantity of lime.

At a high temperature, as we know, caustic lime acts on the uncrystallizable sugar, and on certain other substances which are regularly found mixed with low raw sugar. One of the first conditions of the rational use of lime is to eliminate the excess of lime before raising the temperature. It is one of the most important limitations in M. Woestyn's process, and it is especially important for refineries in which colonial sugar is used, as this always contains more or less glucose.

If it is wished to decolorize molasses by the use of lime and carbonic acid, it is needful to employ such large quantities of lime that it is better to submit it to several consecutive treatments rather than endeavour to effect its decoloration by a single operation. The treatment by lime and carbonic acid appears to be especially useful when the osmose process is employed, as the syrups proceeding from the osmogenes are of a density convenient for subjecting to the treatment, and take by clarification the appearance of good syrups. All those who have used the osmose process know that the alterations which take place so easily in syrups deprived of their salts are among the greatest difficulties of the process. M. Woestyn and myself have commenced during the past year the practical study of osmose syrups from low produce, and have found the use of carbonic acid very satisfactory. We are persuaded that the osmose practice will gain much therefrom, and when we install this process at Arlovetz, we shall complete the small experiments we have been able to make, on some hundred of kilogrammes, thanks to the valuable model apparatus which M. Woestyn has presented to our manufactory.

SUGAR CULTIVATION IN NEW SOUTH WALES.

The "*Sydney Mail*" has published in its issue of the 19th of June last, an "Analysis of Growers' Returns of the Sugar Crop of 1867-8." These returns are made out on forms furnished to the growers of cane by the conductors of the paper. Above one hundred have been more or less fully filled up and returned to them. The analysis is far too voluminous and not of sufficient general interest for entire reproduction in these pages, but we append extracts from the article in the "*Sydney Mail*" which accompanies it.

"The proprietors of this Journal have again the pleasure to present to their readers a comparative view of the sugar crop. It will be seen that a notable advance has been made upon last year.

The degree of progress then anticipated for the current year has been attained. In the observations called forth by the last return it was stated that the cane would, in twelve months, be found to cover 2000 acres of land. Information that has reached this office proves the estimate to have been moderate, for there are not far short of 3000 acres under sugar at the present date.

The county	Camden has	26	acres.
	Durham	3	,,
	Gloucester	240	,,
	Macquarie	1093	,,
	Northumberland	54	,,
	Clarence	822½	,,
	Macleay	645	,,
		2883½	

"The return now presented only deals with the operations of the sugar growers on the Clarence, Manning, Macleay, Hastings, Richmond, and Bellinger rivers. No attempt has been made to afford a complete view, by obtaining a return from every planter. So minute a picture of the subject was not needed. A few returns from those who were most successfully engaged in this industry was all that was aimed at. These, it was considered, would afford a very good idea of what was going on, and would supply sufficient inducement to capitalists, in the shape of confidence, to make such investments as would give further development to this industry. Fully to accomplish the object proposed, this return should prove far more useful to those who are engaged in sugar-growing than to those who only regard it as a field from which they hope to draw a constant and good percentage without trouble. To the growers it is as yet less useful than it will be, since the industry is not sufficiently old to allow of any reliable return being made of the yield of the cane. The machinery in operation was so scanty when these papers were filled up, and generally of such inferior construction, that the few results forwarded are absolutely worthless. The profits of the grower can only be seen from a comparison of the cost of cultivation, and the amount and value of production. The table supplies the first, but not the last. Another year must elapse before any satisfactory information can be gained relative to the paying nature of this occupation.

"With respect to the mode of preparing the land, some valuable information is obtained. Whereas some growers have endeavoured to spread their capital over the largest space of ground by doing as little as possible; others, with a wise forecast, have preferred to depend upon the result of a smaller space well tilled. There is a vast difference in the outlay encountered, and perhaps more difference than there would have been had rent, plants, and time been always included.

"It may be well to estimate what the expenses, fairly considered, should be. Rent is rising. It varies from 20s. to 30s. an acre. The cost of stumping varies, also, from £3 so £7. Two ploughings appear to come to about £1 15s., a harrowing to 8s., and a rolling to 10s. an acre. Draining has been scarcely attempted, and will not therefore be included. Efficient drainage would cost not less than £5, and would, we think, be seen to have its effect upon the crop. Seed costs about 20s., planting 7s. 6d., a scarifying may be put at 7s., other crop-cleaning work at £1 10s. Trashing is variously estimated; it depends upon the cane; the Fijian canes scarcely cost 20s. an acre, the Ribbon, Bourbon, and China perhaps £4 10s. or £5; cutting may vary within 20s. and 30s. per acre. Therefore the cost of cultivating an acre of cane will average :—

Rent	£1	0	0
Stumping (average)	3	10	0
2 Ploughings	1	15	0
2 Harrowings	0	16	0
2 Rollings	1	0	0
Seed	1	0	0
Planting	0	7	6
Scarifying and hoeing	1	17	0
Trashing	2	0	0
Cutting	1	10	0
	£14	15	6

"This medium estimate leaves out of the question the cost of drainage and liming and subsoiling. Land so treated might be said to be "fairly done." It is not high, but moderate farming; it will yield a good, but not the best return. Well, in looking over the table, it will be observed that few go beyond this, while many sink below it. Turning to the Manning growers' accounts, under this head of cost it will be seen that they have been satisfied with doing much less. There is no return beyond £8. One grower says he can form "no idea of the expense." It is only necessary to ask how any conclusion can be arrived at as to the benefits of such outlay, if no credit and debit account be kept? The growers on the Macleay have been more liberal in their management, and doubtless will reap the reward. Let it be observed that the whole of these initial expenses incurred in preparations should not be debited to the first crop. The first deep ploughing, together with stumping, draining, subsoiling, liming, and planting, should be looked upon as capital sunk, the interest of which, together with a depreciating allowance, should be charged to the growing crop. The rules of valuation in England spread the cost of draining, for instance, over seven years; of manure, generally over three or four. If this be not done when a heavy expense has been incurred the first year, the immediate result, when placed upon paper, will prove very discouraging."

"As yet, liming has scarcely been attempted. The substance is costly—now about eighteenpence a bushel, and a hundred bushels per acre forms a good dressing. These who are experimenting will perhaps publish the result of their experience next year.

"It will be seen that a great many experiments are being made to ascertain what varieties of cane are best suited to various districts. Opinion is at present in favour of the Fijian varieties. Of the four varieties most used the purple appears to be the most popular. A close examination of the measurements of the growing canes will probably help to settle the question respecting the superiority of the first or second ratoons to the plant canes; but this must be left at present.

"Little has been done by the growers towards undertaking the double function of grower and sugar-maker. This is satisfactory. It is undesirable that the two operations should be conjoined. It is better for the manufacturer to master his department, and for the grower to master his. They have both plenty to do to arrive at the maximum of production, at the minimum of cost in the single operation, without attempting it in both.

"In certain cases, doubtless, these functions must be combined. Many men possessed of land in isolated positions, and smit with the fever of sugar-growing, have planted cane without exactly calculating the chances of getting rid of it. The cost of transport will deprive them of the advantage of the distant mill, for when the distance exceeds five miles by land and ten by water, it seems probable that the profits of production will be spilt upon the road. In this case, it may be desirable for growers to have a roughing mill at command, for the purpose of reducing the bulk of the crop and making it more portable. The supply of the family is soon accomplished, and the demand of the district soon supplied; it will not be safe to depend upon either of these mouths for a market. It is clear that a good marketable commodity must be aimed at, and it is much to be feared that nothing of this sort can be attained by small mills. Instead, therefore, of a perfecting machine, some apparatus should be looked for capable of reducing the bulk of the crop to a portable form. A small Concretor might serve this purpose. There is now no market for concrete, but there soon would be under these circumstances. Inasmuch as sugar growing will not be undertaken generally, it is considered, further south than the Manning, at a greater distance than ten miles from the coast in a direct line, and on the Clarence at a greater distance than thirty miles, on account of the effect of frost on the cane, this class of growers is not likely to be very numerous. The coast lands will, as a rule, attract the growers, and there they will find abundance of mill power."

The enterprising conductors of the *Sydney Mail* have done good service to the colony by collecting and publishing the returns; we trust they will continue to do so annually, as every year they will become more valuable. Provided the planters are able to get their canes manufactured into sugar readily, cane cultivation will be profitable in the colony, the price there being nearly equal to the duty paid value in England, whilst those sugar manufacturers who are able to buy canes, at a moderate price of the growers, will make large profits on their invested capital. We observe from some of the returns that it is customary to pay for canes according to the density of the juice produced from them; thus, the Sydney Sugar Company pays 1s. per ton for canes for every degree Baumé which the juice registers, whilst the Clarence Sugar Manufacturing Association gives 15s. per ton for canes of which the juice registers at least 10° Baumé.

As regards the returns from the cane growers, we think rather too much information is asked for, the forms being divided into 22 heads; and yet some of the return papers have explanatory notes appended, with further particulars often of an interesting character.

Although it is difficult by excerpts to give a fair idea of the analysis, we have extracted a few returns of a representative character, omitting the least important heads. It will be seen that nearly all the canes were planted in the autumn of 1868, so that the returns are necessarily incomplete, supposing them to be sent in by the beginning of June, 1869, at latest.

Extracts from the Analysis of the Growers' Returns of the Sugar Crops in New South Wales.

Name and Address of Grower.	Varieties of Cane.				Canes Planted.	Date of Planting.	Distance between Rows and Plants.	Soil—how Prepared.	Cost of Cultivation, including Time and Rent.	Manure.	Average No. of Canes to Stool.	Average Height of Canes.	Average Girth of Canes.	Machinery in Use, or where Manufactured, and Terms
	Bourbon	China	Ribbon.	Purple.										
CLARENCE.							ft. in. ft in.		Per acre.			ft. in.	inches.	
E. G. Chowne, Ulmarra	..	8	2½	½	11	Aug. Oct. 1868..	7 7 by 7 7	2 ploughed and harrowed	....	None.	C 60 R 19	C 12 R 6	C 7 R 4½	None; erecting near
David Lee, ,,	..	..	R	P	12	Sept. Oct. 1868..	66 ,, 5	2 ploughed 9in. worked fine	£10 to £12	None.	P 25 R 20	12	R 7½ P 5½	Do. Do.
Alex Meston, ,,	B	..	R	P	4	Sept. 1869 .... 1 acre 1st Rat.	5 ,, 7	2 ploughed	£7	None.	Rat. B15 R 26 Pl. B 12 R 12	Rat. B 7 R 7 4 Pl. 5	6	Clar. Riv. Man. Ass. 15s. per ton at 10o B
W. Anderson, ,,	..	2	..	3	5	Oct. 1868	P 7ft. by 7ft. C 6 ,, 6	2 ploughed, harrowed & rolled	£6	None,	38	6ft. to head	6	Sydney R. S. Co., 1s. for every degree B.
John Kenny, Warry's Island	..	..	..	8	8	Sept. 1868	7 ,, 7	stumped, 2 plou. rolled & harr.	£18 7s.	....	48	7	6½	Uncertain.
John Cuspin, Carr's Creek	B	C	R	P	2½	½ acre Sep. 1867 2 ,, ,, 1868	6 ,, 5	stumped, ploughed 8in.	Omit stumping & clearing, £4	Part limed.	C 50 R 20 P 40 B 47	C 12 R 10 P 10 B 8	C 5 R 8 P 7 B 7	Nono; Ulmarra mill.
f R. J. Phipps, Norsham	B	C	R	P	5	Dec. 1868	....	stumped, 2 plou. harr. & rolled	£3 10s.	Sedimnt from floods	P 23 B8 R 40 C 40	5	P 5½ R & B 6 C 3½	None; uncertain.
THE MANNING														
G. Allen, Kimbrikee	R	3	B	..	6	5 ac. Nov. 1865 1 ,, Dec. 1868	4 ,, 6	ploughed & harrowed well	No idea.	None.	C 30 R 10 B 6	....	....	Home-mado machinery. *q*
r J. Summerville, Wingham	..	7	..	..	7	1st Ratoons .. Oct....... ...	6 ,, 6	ploughed & harrowed	£6	Nono.	47	5 6	2¾	None; no mill.
Ezra Perrett, Jones Island	2	1½	2	..	5½	1½ Ratoons .. 4 pl Sept. 1868	7 ,, 5	As for corn	£6	None.	R 30 B 18	R 8 6 B 9 6	R 5 D 7	None. *u*
Jos. Andrews, Woodside	..	..	..	..	45	Some Ratoons Aug. to Oc. 1868	4 ,, 6	*s* 2 ploughed	£7 2s. 1d. *y*	None.	C Rat. 50 B Rat. 12	5	4½	Mills erecting. *x*
J. B Hammond Scott s Creek	*a*2	..	..	..	¼ 1st Rt. 3	Sept. Oct. 1868..	ft. ft. ft ft 7 by 7 & 8 by 5	2 ploughed, rolled & harrowed	£8	Ratoon limed.	1st Rat 20	9	3½	None.
MACLEAY RIVER.					3					None.				
M C. Caimane, Summerland	..	..	3	..		Sept. 1868	9ft. by 9ft.	1 ploughed	£9		70	....	6	....
HASTINGS.														
J. Redgate, Fern Bank Ck.	..	..	3	..	3	Oct. 1866	5 ,, 6	cleared and ploughed	£9	None.	8	8	6	Small mill and centrifugal *d*1
BELLENGER RIVER.														
*d*6 T. Salter, Mount Ellis		..	4	..	4	3¾ 1st Ratoons ¼ Plant......	7 ,, 7	ploughed 12in. to 18in.	£3 10s. without plants	None.	35	Pl. 7 Rat. 14	6½	None; uncertain.

Notes to Table on Previous Page.

g R. P. says there are over 100 acres of cane on the North Arm. A considerable quantity will be planted next season, even without the prospect of a mill at present. The results I have had with a camp oven show over 4 tons per acre. Some patches of cane would yield more.

q Simple horse mill, with wooden rollers 2ft. 2in. in diameter, with iron cogs and iron frame work, driven by a bevel pinion; cost about £55; boilers of galvanized iron with wooden frame-work, two holding 40 and one 80 gallons; cost each, 12s.; home made, make only for my own use.

r Machinery sadly wanted in this district: 30 acres quite ready; old cane; any number of farmers willing to become growers. Some portion of the capital might be raised here.

t The Tahiti, or China cane, has a preference over the Ribbon, as it does not require trashing.

u Terms half of sugar and treacle. From half an acre of land got 24 cwts. sugar, and 30 cwts. treacle. Sold my part of sugar at the rate of £46 13s. per ton, and treacle at 2d. per lb.—equal in all to 4 tons per acre. I have included cost of cutting and delivery of cane to the river, where my cost ends, the crusher taking conveyance to the mill. This is the most expensive item, and cannot be done under 7s. 6d. per ton by European labour, and my plant crop of cane yielded 60 tons per acre.

Dr.	£	s.	Cr.	£	s.
Cutting, &c.	22	10	4 tons of sugar @ £37 10s...	150	0
Planting, &c. ..	5	6	Less half	75	0
	27	16		75	0

I think the crusher would be remunerated with one-third in place of one-half.

y I reckon about one man to every 7 acres on the plantation; wages about £50 per annum. Less men may do when our system is improved.

z The machinery and buildings, with erections, will cost about £1000, when the air pump for the vacuum pan and the centrifugal are added to the works already erected.

a^2 About 20 varieties from Batavia, Fiji, and New Caledonia.

d^1 Has a small mill of his own construction, worked by one horse, and boils in a galvanized iron boiler; also a small centrifugal of his own construction, worked by hand, that cost £60.

d^6 About 100 acres of cane are planted on this river, and as soon as a mill is erected, every settler will plant largely.

BEET-ROOT SUGAR CULTIVATION IN ENGLAND.

By Alfred Fryer.

The beet-root industry is so profitable in parts of France, Germany, and other countries, that it will most likely continue to extend throughout the continent of Europe, wherever the climate and soil are favourable, and will *very probably* take root, and make some progress in England. In fact, it may already be said to have taken root, one establishment for the manufacture of beet sugar being now in full operation in Suffolk; but whether in a country where the price of land and labour are so high as in England, it will long continue to be profitable is another matter. This mainly depends on the progress made by the Cane Sugar Industry. The time may not be far distant when cane agriculture and manufacture will be conducted on more advanced principles than are usually applied at present; the cheapness with which sugar can be made from cane will lead to the extension of its growth to such a degree that the price of sugar will fall to a point at which beet-root sugar manufacture ceases to be profitable. This effect may not be brought about for many years to come, and in the meantime, and especially in the earlier part of the interval, beet-root culture will probably be very lucrative. But in the prospect of the indefinite extension of cane culture—and we see that it is extending rapidly in many countries—it is important that as little money as possible should be invested in plant that may eventually become valueless. Indeed, whether this anticipated extension of cane culture be realised or not, it is equally certain that the manufacturer of beet-root sugar will obtain the largest per centage of profit by the investment of the smallest amount of capital, consistent with his taking the produce to market in a state in which there is a good demand for it; always provided that the product is not injured, and that the process is economically designed and arranged. Now, to erect all the complicated and expensive apparatus of a sugar refinery, in addition to that required for the extraction of the juice, and then to work the plant *only during crop time*, say for 100 to 120 days, and attempt to compete with British sugar refiners, who will be working all the year round, would be to subject the beet-root to a severe and unnatural competition, which nothing but the *very* profitable nature of the enterprise could overcome. The sounder policy would be, to concentrate the juice into beet-root concrete (which could be done at much less expense than making it into sugar and molasses); and to sell this concrete as a crude raw material to the refiners, whose competition among themselves is so keen as to ensure the full value being obtained for the beet-root concrete. From experiments which have been made with the Concretor on beet-juice, the feasibility of its making good concrete has been proved; and these experiments have also shown that a concreting apparatus is the simplest beet-root raw sugar factory.

The Concretor is the only machine that will make concrete. Granular sugar can also be made by it as well as by any other system; but if sugar is made, centrifugal machines must be used for the separation of the molasses. Tanks and crystallizing vessels must also be provided; and, in fact, instead of making a beet-root raw sugar factory which will bear competition with any process by which raw cane sugar is produced, a sugar refinery will have been established, which, working only quarter time, is so heavily weighted, that it must be hopelessly beaten in the race, and the profits from beet-root culture will be absorbed by losses in refining.

The following letter on the subject of beet cultivation has appeared in *The Times*:—

In your leader of Thursday last (Nov. 4), upon British compared with continental agriculture, you observe that "one practical obstacle in the way of acclimatising this particular culture, that of sugar growing, in England would be the necessity it creates for the farmer to become something of a manufacturer also." Now, as far as the Lavenham Factory is concerned, no such necessity exists. Mr. Jas. Duncan, the large sugar factor of Mincing Lane, London, with a boldness and a faith that deserve and will command success, erected a factory wholly at his own expense. He sunk, so it is reported, between £8,000 and £10,000 in buildings and machinery without even exacting a guarantee from the farmers that the raw material to fill the one or to set the other in motion should be forthcoming. The only favour he asked was that they should try the crop. If it paid them as well, or better than any other, of course they would continue to grow it and feed his factory, but if not—well, he did not expect them to grow it at a loss, and no farmer is under any obligation to grow it at all. There is no copartnership in the matter. Should the venture prove a failure, no farmer will be a penny the poorer. If a fortune is made out of the sugar no grower will directly participate in the profits. Indirectly this new industry promises substantial benefits to the farmer. He is left free either to grow sugar beet or not, as his interests prompt him; but his price, both as a seller of the root and a buyer of the pulp, is guaranteed. For every ton of roots delivered at the factory he receives one sovereign; and he carries back to his farm dry pulp or beet bread at the rate of 12s. per ton.

In these two statements we have the profits of Sugar Beet-growing concentrated, as it were, into a nutshell. The feeding value of common mangold has been assessed at about 7s. per ton. It is worth about as much for conversion into beef. Of course, in the vicinity of towns, it has a fictitious value, for the use of milch cows, &c. But the above is a fair estimate of its average worth. sugar beet, weight for weight, is worth possibly for conversion into beef, 10s. per ton. The excess of sugar makes it more valuable for feeding purposes. But, assuming its superiority, here is 10s. clear profit to the farmer, minus, however, the expense of cartage, by selling it to the sugar-maker. But this by no means exhausts the farmer's advantages derived from sugar growing. Of course when a farmer converts his mangold or his sugar beet into beef there is an end of it. The 7s. 6d. or 10s. per ton exhausts its value. But it is far otherwise with the roots sent to the sugar factory. When at Lavenham the other day, which is just now all excitement and bustle harvesting its sugar beet, I observed that nearly all the carts were laden both ways. They carried beet in, in the gross, and were carrying most of its flesh-forming matter back in detail. It requires eight tons of beet to form one pulp, and this pulp is the veritable essence of the beet itself, minus all its water, and, perhaps, four-fifths of its sugar. The experience of last season proved beyond all controversy that the pulp is most nourishing and grateful food. Stock of all kinds, including horses, eat it greedily, and do remarkably well upon it. Bullocks were found to fatten as rapidly on a peck of pulp mixed with chaff or cut straw as they were wont to do on a bushel of oats. By sugar-growing thus we arrive at a clear profit of say 10s. on the raw roots, and another profit on a cheap nutritious food which will keep sweet and good for six or eight months, is greedily devoured by stock, and rapidly converted by them into beef and mutton, milk, butter or cheese. This expense of growing sugar beet need not exceed that of mangold. The culture and treatment may be identical in their main features, only the sugar beet may be grown closer together—18in. by 9in. is a good distance, and the root should be earthed up to the leaves.

On good soils, and in favourable seasons, 20 tons an acre may readily be grown. At Lavenham, this year, the beet crop, on the 20th of September, reached 21½ tons per acre, and 9½ tons of tops, or a gross yield of 31 tons. The average would be about 16 tons. But wire worms had been very destructive among the young plants, and an unusual quantity of the crop had bolted or run to seed. These runaways and the blanks played sad havoc with the gross returns. Had there been a full plant, the average would certainly have reached 20 tons to the acre. By growing 200 roots to the pole, and cultivating them up to about 3lbs. per root, 40 tons per acre might be netted. The latter weight seems quite within the range of possibility, as at the exhibition of roots in connection with the Lavenham Farmers' Club, last week, the sugar beet shown averaged 5lbs. each root. The sugar factory is now in full work night and day, with three relays of hands in the 24 hours, doing about 160 tons of roots, with sugar and pulp during that period. Already it has quickened thought as well as ploughs, and sent both deeper down in quest of new, and perchance better materials. It is reported that about the produce of 400 acres will find its way to the factory this season. Operations are vigorously commenced for next year's sugars. Two steam cultivators have been tearing through the bottom of the furrow, and making deep tilth in the field. Workmen are becoming more scarce. "They are all off to the factory," is the cry. Wages are looking up; money is flowing in, and the quiet old place, from genteel mansion to tottering garret, seems to feel the quickening pulse of the sugar factory and the starting forwards on the road to agricultural improvements and to social progress. Without any of the risks of manufacture, the farmers seem about to reap many of its advantages, one of the chief possibly being an increase in their bankers' balances at the dead season.

D. T. Leek.

SUGAR PRODUCTION IN NEW CALEDONIA.

The climate of the island of New Caledonia is, from its geographical position, peculiarly adapted to the growth of the sugar cane, and it appears to have been comparatively lately discovered that its soil and other physical characteristics are equally so. Being just within the tropics, frost is of course unknown, and as the length is considerable in proportion to its breadth, no part of it is far from the sea—an important consideration as regards the expense of carriage. Its superficial area is about 4½ millions of acres, so that there is ample room for the growth of abundance of cane without any fear of exhausting the soil. A chain of mountains covered with forests runs through the centre of the island, by which the mists of the ocean are collected and discharged in nightly showers, so that the island is well watered by abundant streams and rivers. Two sorts of rice are indigenous to the island, one growing on the low lands near the coast, the other in the mountainous parts. But, perhaps, the most important fact, and the one which is conclusive as to the suitability of the soil, &c., for the growth of the sugar cane is this:—thirty-two different varieties of cane are found in the island.

There are natural harbours all along the coast, many of which deep and commodious; a coral reef running all round the island contributes to their safety.

The chief difficulty here, as in other sugar-producing countries, will be the supply of labour, as the native population is thinly scattered, the total number being only about 45,000. Although the island was discovered by Captain Cook, it does not appear to have been sufficiently tempting to be secured as a British colony.

One or two Protestant missions have, it is said, been sent to the island, but only to be withdrawn. Since the year 1853 New Caledonia has belonged to the French, who have sent a Governor to it and a Catholic mission; gradually, a number of colonists have settled, by whom the manufacture of sugar is now being attempted. The progress which this industry has already made there may be seen by the following extracts from a letter which lately appeared in the *Journal des Fabricants*, from a colonist in New Caledonia :—

M. Andre Marchand has shown in your pages how advantageously French capital could be employed in this colony; but political reasons have hitherto stood in the way.

The first French colonists with capital who arrive to develop the sugar industry in New Caledonia will find their task an easy one, as the experiment has already been made, and most of the difficulties overcome; in short, the establishment of the sugar manufacture in New Caledonia is an accomplished fact.

The first manufactory was set up at Koé by Messrs. Joubert, of Sydney, originally from France. These pioneers of the sugar industry had to struggle against difficulties of every sort; but they were not disheartened, and Koé is now progressing under very favourable conditions. Honour to Messrs. Joubert! without great energy and perseverance they would have met with discouraging checks, which would have prevented others from following in their track.

The Mariste Fathers have a "Usine" at their mission of St. Louis, in which they have produced sugar for above a year.

These two mills, the oldest in the island, are driven by water power. The first steam sugar machinery has just arrived here (August 18) from Reunion. It is intended for the manufactory of Messrs. Duboizé and De Gresland, who have hitherto had their magnificent canes crushed at Koé. M. de Gresland has brought with him nearly 300 coolies, whom he has engaged at Reunion. The voyage was favourable, and accomplished very rapidly, and the undertaking has been so far remarkably successful—as, indeed, how could it be otherwise? M. de Gresland having found at Reunion a *white Blackbird*—such was the name of the ship which has so successfully brought himself, his immigrants, and his machinery to New Caledonia.

The same mail which carries this letter takes to Reunion M. Buette, who is going there in search of steam machinery for the "Anonymous Company of Tamoa." This company, with a capital of 100,000 francs, in shares of 100 francs, is of truly national importance: it has been formed solely by the exertions and with the capital of the inhabitants of Nouméa and its vicinity. All have been anxious to invest their savings in this enterprise, which has been taken up with admirable enthusiasm and celerity. The company do not propose to grow their own canes, but to crush those of the colonists of the valley of Tamoa, from the furthest part of the bay of St. Vincent on the west coast, who are engaging in the work of cane culture with an ardour equal to that of the colonists of Nouméa, who find the capital for the "Usine." The directors who organised the company have inspired such confidence that they have all been re-chosen definitely.

M. Buette will, no doubt, honourably fulfil the mission with which he is charged. The accounts brought by M. de Gresland have given us great confidence in the complete success of the undertaking. The Governor of New Caledonia has engaged to transport the machinery gratuitously from Reunion to Nouméa by one of the ships of the Imperial Marine.

The inhabitants of Paita on the west coast, south of Tamoa, wish to have a "Usine" soon. They plant the canes, whilst the missionaries carry on the manufacture. The colonists' canes also go to the mill of the Reverend Fathers, who are thus, to some extent, "Usiniers."

To conclude: at Bonloupari, to the north of the bay of St. Vincent, the colonists are preparing their ground, and beginning to plant canes, expecting the establishment of a "Usine" before very long.

Thus, in the course of a year or two, there will be five "Usines" erected and at work in New Caledonia.

Land in the neighbourhood of these projected cane mills has increased in value, the nominal price of 25 francs per hectare having in some instances been more than doubled.

Facts Relating to Inverted Sugar.—M. Maumené.—The so-called inverted sugar is prepared by the author in the following manner:—Perfectly colourless sugar-candy is pulverised and thoroughly washed, first, with pure ether, and then with perfectly pure absolute alcohol; the powder is next dissolved in about five times its weight of very pure distilled water, to which is added 1 c.c. of pure concentrated hydrochloric acid (this quantity of acid is sufficient for the converson of 1 kilo. of pure sugar). The aqueous solution is heated on a water-bath for a few hours, until colouration just begins to be perceptible. The HCl is removed, by the quantity of oxide of silver required for that purpose, with only five millgrms. excess; the chloride of silver is separated by filtration; the filtered liquid treated with sulphuretted hydrogen, to make perfectly sure of the removal of all metal; the liquid again filtered, and next evaporated upon a water-bath, yielding perfectly pure glucose.—*From the Chemical News.*

SUGAR, GLUCOSE, AND SACCHARIMETRY.

BY M. DUBRUNFAUT.

From "La Sucrerie Indigene."

THE question of glucose, and its presence in noticeable quantity in sugar, even in refined, is one of considerable importance. It is a real impurity, and if the refiner who buys sugars by their melassimetrical standard—that is to say, according to their actual value for working up—has a right to take account of every element of impurity, the raw sugar manufacturers and the merchant have the right to know and to discuss the bases of the correctives, which the presence of these impurities call forth.

Many publications have been issued on this question, in consequence of the legal claims of the various interests involved, and M. Woussen has discussed this point in the last report of the "Central Committee of Sugar Manufacturers."

I may be permitted, in my turn, to discuss this question with the light which a long experience of the matter has enabled me to bring, and I do so with the more confidence, because it will be difficult for the subject to be treated without dwelling on my works and publications.

The question has often been asked at different periods, whether the argument which M. Woussen has lately reproduced to combat the principle of glucose correction has any foundation, and I have always responded negatively to this question. I can no longer excuse myself from justifying this opinion.

What is called inverted sugar is truly, as M. Woussen observes, a definite composition of glucoses of opposite rotations. The coefficient of inversion of this sugar at a temperature of 67 Faht. is, as was indicated by M. Biot, 0·380—that is to say, that a given weight of cane sugar, which has a rotatory power to the right of 100, has after inversion a rotation to the left of 38. A similar sugar mixed with equal weight of crystallizable sugar will evidently annul $\frac{38}{100}$ of direct rotation, and consequently $\frac{38}{100}$ of the value of a crystallizable sugar based on saccharimetrical valuation.

Admitting this premiss, let us see what may be its influence in the determination of the saccharimetrical valuation of the beet sugars of commerce. Let us take as our basis the incongruous figures lately put forward by an opponent of the glucose analysis—that is to say a sugar which, in the hands of various commercial analysts, has given from 0·165 to 0·505 of glucose to 100 parts of sugar under valuation.

The glucose impurity will then have varied in these circumstances, according to the valuers, from between 16 and 50 ten-thousandths. If we consider that the saccharimetrical valuations made on the received bases are not able to guarantee a precision nearer than 1 per cent., we recognise that in the aforesaid conditions, which include the generality of cases, the melassimetric valuations cannot be sensibly affected by the presence of glucose, even when these glucoses are composed of inverted sugars.

Mitscherlich has discovered a sugar which he has made known under the name of (optically) neutral sugar, that is to say, without rotatory power, and which he has produced by altering the nature of cane sugar by the aid of heat.

We have proved elsewhere that this neutral sugar is nothing else than sugar, inverted in such a manner that its opposito elements of rotation are found in equal optical proportions, and this is very often, if not always the case with glucoses that are met with either in molasses or in the sugars of commerce, even when these are produced from the cane.

Such are some of the arguments which we adduced against the inversive method, when the saccharometer was proposed during 1850 as the base of transactions in sugar; and in a long practice of the use of the saccharometer, we have rarely found it needful to have recourse to inversion.

Our opinion and experience have prevailed, for the saccharometer is now generally admitted only for the use of direct rotation, as we recommended in 1850; and if the arguments advanced respecting the causes of the perturbations of glucose had been sound, our opinion, instead of prevailing, would have been refuted by facts and truth.

It may then be affirmed with certainty that the normal presence of glucose in the sugars of commerce cannot affect in any appreciable degree the indications of the saccharometer employed agreeably to the received custom, with direct rotation alone. Glucoses found in sugars are either optically neutral, or they are found in such proportions that their proper rotation as inverted sugar escapes the measure of the saccharometer.

It is only by a chemical method analagous to that which has been conceived by M. Barreswill, that the quantity of glucose can be ascertained, and this is in effect the only means employed by commercial analysts.

This method, based on a characteristic reaction, is doubtless one of delicate manipulation, and may thus effect some variations of exactitude in the hands of various experimentalists. It can in fact measure extremely small quantities of glucose; with care, these proportions may be valued to the ten thousandth or even the hundred thousandth of a gramme. Can the excessive delicacy of a most valuable reagent be used as an argument against its value and against its use? Assuredly not.

In the case cited above, the difference between the analysts reached to 34 ten thousandths of a gramme in 100 grammes; and the correction allowed to refiners is generally an equal weight of crystallizable sugar.

To justify this base, they admit that the glucose existing in sugar withdraws in refining an equal weight of crystallizable sugar, in the form of molasses. The correction in question then is only reckoned by ten thousandths, *i.e.*, on quantities much less than the 1 per cent. which is the limit of error allowed for the saccharometer.

Of what value, then, in this case, is the critique opposed to the glucose correction.

When this correction is reckoned by hundredths, as it may be in the case of cane sugar, the objection is more valid, and as it is expedient that the bases of commercial transactions should adequately represent the generality of cases which may be presented, it may be opportune to discuss the legitimacy of the glucose co-efficient, as that of the saline co-efficient has been. From whence it may be useful to seek to give to this co-efficient not less certain bases than are admitted in the other.

One of the inconveniences of the Barreswill method is, that it uses a chemical reaction, which is not exclusively characteristic of glucose—that is to say, the reduction of Cu O into Cu^2O under the influence of the alkalis of substances with affinity for oxygen; it is, in fact, known that a certain number of substances have been discovered to possess this property.

Meanwhile, in the generality of cases in which the copper reaction has been used as the base of saccharimetry, it has given figures which have inspired sufficient confidence in habitual analysts as to justify its adoption. Such, at least, is the opinion of MM. Fehling, Violette, Landolt, and other *savants*, who have carried the process to perfection.

The important question in this species of application is to find out all the particularities which may falsify the indications, and to prove and control their exactitude by other reactions, which may themselves prevent the causes of error.

By proceeding in this manner we have shown the vice of the inversive method as applied to the analysis of beet-root, where the presence of asparagine renders the measurement difficult. Dr. Scheibler has discovered an analogous cause of error in the metapectic acid, which troubles the indications of the saccharometer exactly in the same way as asparagine, inasmuch as it possesses normally a rotatory power to the left which is transformed to a rotation to the right under the influence of acids.

In employing for a length of time the Barreswill method in our analyses of saccharine matters, we have abstained from basing our process on the general method of saccharimetry, as wished by Messrs. Landolt and Violette, and have limited its use to ascertaining the presence of glucose and the proportion of crystallizable sugar which escape perception in the saccharometer, and in the last case we are evidently obliged to invert the sugar previous to subjecting it to the copper reaction.*

In similar conditions the method is always useful, and sometimes quite necessary, as the copper reaction is the only one known which can be usefully applied to small proportions of matters.

Some time ago we made known a method which we have used exclusively since 1849 or '50, in the determination of the glucoses in molasses.

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* The German chemists who lately met to confer on the saccharimetrical methods, have, it is said, decided to give the copper test the preference over the saccharometer, which is, at present, the most commonly used. This preference may, without doubt, be justified from certain points of view; but our observations noted in this paper, and all the observations of the same order which we have made heretofore, lead us to the conclusion that the substitution proposed in Germany needs certain precautions; this we intend to examine elsewhere with some enlargements, in a work on "Sugar and Saccharimetry." We must not, however, delay to point out a cause of grave error which has been introduced into the practice of the Barreswill process: we mean the acetate of lead, and of its corrective, the sulphate of soda. The use of these agents, preceding the copper reaction with the aim of decoloration, falsifies the indications to the extent of reducing them to the third or fourth part of their true value. This will partly explain the errors of glucose analysis, and the variations observed in the figures given by different analysts of the same sugars.

This method is based on the property which caustic alkalis possess of transforming the glucose into organic acid, which in given conditions saturates them in constant proportions; and whatever may be the simple or complex nature of these acids, when their exact equivalent has been ascertained by saturation, we can judge with sufficient exactitude of the glucose and its proportions.

Our practice consists in heating to the boiling point, for a few moments, the liquid, supposed to contain glucose, with the addition of a standardised alkaline fluid, and the quantity of glucose is estimated by the proportion of alkali displaced by the aid of a constant co-efficient. Thus we have discovered by numerous experiments that the disappearance of 830° of the alkalimetrical liquid of Guy-Lussac, or $41{\cdot}5\ S\,O^3\,H\,O$, correspond to 100 grammes of cane sugar transformed into glucose. Such are the empirical numbers which have served us as bases for the determination of glucose in molasses.

The method is simple and easy of application; it is sufficient to take a certain weight of the suspected molasses and mix with it a solution of standardised caustic soda in suitable proportion, and then to make alkalimetrical assay of the altered liquid. The proportion of the alkali displaced gives the proportion of glucose, with the aid of the co-efficient, 830°.

We have had occasion to compare the results given by this method with the more precise figures obtained by the Barreswill method, and we have always found them to agree.

One might have thought *à priori* that the liquids which had been subjected to the sodic reaction by our method might yet be submitted to the copper reaction. It is not so, and if the alkaline reaction of the copper test really produces the transformation which provokes the reduction of the oxide of copper, this reaction must invariably be effected in the presence of copper. Thence, doubtless, the explanation of this important fact—that, in order to preserve to the Barreswill method its value and precision, its original character must be retained, which has been modified by the use of standardized liquids in the inversion of the bases. There, in effect, we seek for the variable volume of liquid glucose which shall reduce a constant volume of copper solution, and if we wished to proceed otherwise, as some inexperienced analysts do by falsified indications, the fact cited above is proved that it is useless to apply the copper reaction to liquids remaining from our alkaline process.

In this method, the alkali displaced which fixes the glucose standard, represents nearly 1½ equivalents of soda to one equivalent of glucose.

This fact proves that the derivative of the glucose which is produced in these conditions is not the glucic acid of M. Peligot, and it corresponds with sufficient exactness to the known composition of apoglucic acid.

We are assured that in the copper reaction the oxidation of the glucose is effected with the production of formic acid. Some works recently brought out in Germany tried to prove a more complete reaction, which gives birth, at the same time, to formic, oxalic, tartaric, and other acids.

We willingly admit these results, since they accord with the fundamental differences which we have recognised in the composition of inverted sugar.

We have proved in effect, by experience, that in boiling cane sugar for a long time with sulphuric acid, as has been done by M. Malagutti, the levulose alone is modified and transformed into formic acid and into ulmic products, according as the reaction takes place in the presence or in the absence of the oxygen of the air.

The right-handed glucose and sugar of milk resist in this case the action of the acids, whilst the levulose is entirely transformed.

In the various conditions in which inverted sugar is found in the sugar factories and refiners, the sugar is submitted to the modifications analogous to those to which it is subjected under the influence of acids, and it is always on the levulose that is exercised by preference the action of the transforming agents, such is the combined action of heat and of water; and it is thus that the partial transformation of inverted sugar, in the process of refining is explained, and the presence of sugar optically neutral in the produce.

The copper test, well employed, is of such precision as renders it precious, and this precision depends less on the divers formulæ used in the composition of the test liquor, than on the care which is taken in its use and in the determination of its true standard.* This standard needs frequent verification by means of a standard solution of pure glucose, for the liquor may be altered in certain conditions little known, and not easily defined.

The proportion of glucose contained in beet root sugars, being generally found there in quantities so small as to escape the analysis of the saccharometer, has for a long time been neglected, since it was thought that the saline co-efficient and the amount of crystallizable sugars were the more important questions; and it is only at a recent period that attention has been directed to this impurity, of which the full importance does not appear to have been appreciated either in an industrial or commercial point of view, nor yet by the refiner.

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* Three or four formulæ are known and used in the preparation of the copper solution, but the principal bases are always the same—these are the tartar, or salts of "Seignette," the sulphate of copper, and an alkali in variable excess (soda or potash). This reagent has been reproached with an inaccuracy which it does not deserve, that it will give oxide of copper by simple ebullition: this is not the exact fact, and if it is produced in this way, it can only be with an impure liquid, or by the use of improper vessels.

When notifying the unexpected fact of the presence of glucose in refined sugars, we looked out for the cause, which we found without difficulty in the inferior quality of the raw material, which is, nevertheless, confidently presented as being the product of perfect processes.

On that occasion we raised the alarm, and put the trade upon their guard against methods of working, which are evidently prejudicial. We pointed out, gratuitously, the means at their disposal for getting on the right track again. The future only will show whether we have been heard and understood; but we think it well now, when a fresh crop is about to be worked, to refer again to our observations and criticisms, whilst, at the same time, we present a simple method of proving the presence of, and ascertaining more accurately, the quantity of the glucose impurity.

Let us now proceed to consider this last point in some of its explanatory details, so as to complete those we have already given in this paper.

The greatest and most frequent cause of error occurring in the use of the Barreswill process for determining glucose lies in the power possessed by certain derivatives of glucose to interfere with the reduction of the copper, although these glucoses are so transformed as to exist no longer either in the sugars or in the syrups in the state of any saccharine substance whatever.

(To be continued.)

FLUOSILICIC ACID FOR REFINING SUGAR.—M. Marix has obtained a patent in France for the employment of fluosilicic acid in purifying beet-root and other saccharine juices. The juices are diluted with water, to remove viscidity, and sufficient fluosilicic acid is then added to precipitate all the salts of potassium; powdered chalk is then used to saturate any excess of the acid. A clear liquid is next obtained by filtering, which is heated afterwards in the usual manner.

SUBSTITUTION OF MAIZE FOR OATS IN STOCK FEEDING.

To the Editor of the "Sugar Cane."

Dear Sir,

Although the subject of my letter may be but remotely connected with the object of your Magazine, yet in all agricultural operations the feeding of the stock employed in working is such an important item in the necessary expenditure, that a few details respecting the most economical kind of food may not be out of place in "*The Sugar Cane*."

During the present and part of last year some important experiments have been made by the directors of the London General Omnibus Company, establishing the fact that maize, or Indian corn, is more economical than oats in the feeding of horses, and also (which is a very important fact) that the horses are kept in much more healthy condition by the use of it.

Perhaps I could not do better than give you an extract or two from the last half-yearly report of the company above named:—

"The number of horses engaged in the omnibus service on the 30th of June, 1869, was 6,569; the number which died or were sold during the half-year was 632, being 381 less than in the corresponding period of 1868. The saving to the company by this decreased loss amounted to £7,162 13s. 2d."

"In no previous half-year during the existence of the company have the expenses of horse maintenance been so low. The horses continue in excellent working condition, and very little sickness prevailed."

"The very encouraging results which attended the use of maize as provender in the previous half-year induced your directors to adopt it still more extensively during the past half-year, and at length to substitute it entirely for oats. During the summer no other grain has been used for the working studs."

"The substitution of maize for oats effected a saving of

£14,172 8s. 8d. Fourteen thousand one hundred and seventy-two pounds 8s. 8d. in the half-year!"

These facts, Sir, speak for themselves, and without being desirous of perpetrating a pun, may be said to be amaizing.

I will only add that, having tried the experiment with my own horse, I find it fully bears out the advantages to be derived from the substitution of the one grain for the other. I may also remark that the maize should be bruised.

I am, Sir,
Yours truly,
D. A. C.

The subject of our correspondent's letter is quite pertinent to the object of our Magazine. Every cane planter knows the value of economy in stock feeding, and, although West Indian proprietors are sometimes reproached with being behindhand in adopting economical improvements, it must be conceded that in this respect they are in advance of the general practice, maize being very commonly used by them for feeding the mules and oxen employed on their estates.—*Ed. S. C.*

The Confederation of the Leeward Islands.—It is stated that Sir Benjamin Pine is in treaty with the West India and Panama Telegraph Company for a line of cables to be laid, connecting the islands under his government as part of the confederation scheme which he is hoping to carry out.

Events in Cuba.—A despatch from Havana, dated Nov. 14, states that on the previous Thursday seven cane fields in the vicinity of Las Cruces were burnt. Four Chinamen were afterwards discovered in the act of firing another cane field. They were seized and immediately executed. The settlement of Taguayaben, which was defended by 30 volunteers, has been captured by the insurgents and burnt. The insurgents were defeated while attempting to capture a railroad train. Troops have been sent to Taguayaben from Remedios.

THE "DETAXE" ON FRENCH COLONIAL SUGARS.

From "La Sucrerie Indigene."

THE official journal of the 13th November contains the following announcement:—

"By the decision of the Minister of Finance, taken by the advice of the Ministers of Agriculture and Commerce, and of the Marine and the Colonies, sugars from the island of Reunion, which the state of the sea may have prevented shipment before the 1st of January, 1870, will enjoy on their importation into France the 'detaxe,' according to the law of the 7th May, 1863, on the conditions of their being in depôt at the port of departure, and that the impossibility of shipment being effected before that date shall be fully proved."

"Nevertheless, notwithstanding these concessions, the 'detaxe' shall only be applicable to any sugars which are shipped before the 1st of March, 1870."

This second decision appears to us, to say the least, just like the first with regard to the law; for, in short, the delay granted was final—it resulted from a law voted by the "Corps Legislatif," and we have a right to demand to what point a Minister of Finance may exempt the goods of a part of the community from the duty, to the detriment of the exchequer and of an entire branch of industry.

By the opening of the Suez Canal, the island of Reunion is to-day only a little further distant from Marseilles than the Antilles are from Nantes or from Havre. From this point of view it is still more difficult to account for the favour shown to the African island. For the rest, only one thing is more elastic than the condition respecting the warehousing at the point of embarkment, and that is the impossibility of effecting shipment. In fact, this is a new prorogation accorded to Reunion up to the 1st of March, and we do not see what good reason can be opposed to the planters of the Antilles if they also should claim the enjoyment of the "detaxe," as accorded to the others, till the 1st of March.

DETERMINATION OF THE CONDITION OF ANIMAL CHARCOAL USED IN SUGAR REFINING.

BY M. B. CORENWINDER.

From "L'Agriculture Flamande à l'Exposition Universelle de 1867.

THIS process is based on the property which animal charcoal possesses of removing from a solution of sucrate of lime a quantity of lime, varying according to the quality and granulation of the charcoal.

It is found that the absorbent power of the charcoal for the lime is in proportion to its decoloring power, to such an extent that the former may be taken as the measure of the latter.

The operation is conducted as under :—

Two solutions are prepared—first, a normal liquid containing 20 grammes of monohydrated sulphuric acid per litre; also, a solution of sucrate of lime of such strength, that equal volume of it will exactly saturate the former.

In making a determination, take 50 grammes of the charcoal to be tested, and a decilitre of the solution of sucrate of lime ; let them remain in contact for an hour at a temperature of about 60° Fahrt., shaking the mixture frequently during the interval.

When the time has elapsed, filter ; then take 50 cubic centimetres of the clear liquid, and determine by the use of the acid solution how many divisions on the alkalimeter are required to effect saturation. If it takes, for example, 40 divisions, we may conclude that 60 divisions [of the lime] have been absorbed by the charcoal, and that the standard of the latter is 60.

This method has been in use in a sugar manufactory in the north of France for fifteen years, and great benefit has resulted by reason of the regularity with which the operation can be performed. It is now employed in the north of France by all manufacturers who study their own interests.

Phosphate of Lime.—From the *Journal des Fabricants* we learn that M. Ville, in a recent work on chemical manures, states, that by the use of phosphate of lime, which exercises great influence on the cane, whilst nitrogen has only a secondary effect, tho saccharine richness of the cane may be greatly increased. For practical proof of this he refers to the results obtained in Guadaloupe, where, on analysis, canes grown by the use of phosphate of lime gave 17·8 per cent. of sugar, whilst others only gave 11·52. He further states, and in his work gives drawings to prove it, that in the physical aspect of canes grown with phosphate of lime, and without it, there is a still more remarkable difference than in their chemical composition, as shown by analysis.

Stocks of Raw Sugar in the Chief Markets of the World, in thousands of tons, to September 30.

	1869.	1868.
United Kingdom	141	150
France	27	50
Holland	30	43
Zollverein	4	5
United States	121	83
Cuba	40	42
Total	363	373

Consumption in Europe and United States for year ending September 30.

	1868-9.	1867-8.
Europe	1235	1173
United States	410	412
	1645	1585

SUGAR STATISTICS—GREAT BRITAIN.

To 20th Nov., 1869 and 1868. In Thousands of Tons, to the Nearest Thousand.

	STOCKS.						IMPORTS.						DELIVERIES.					
	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.	London.	Liverpool	Bristol.	Clyde.	Total, 1869.	Total, 1868.
British West India	12	1	1	6	20	42	87	9	12	43	151	188	95	11	14	44	164	170
British East India	11	5	..	..	16	7	17	7	..	..	24	7	11	6	..	..	17	9
Mauritius	3	..	..	..	3	8	8	1	5	4	18	39	11	1	5	5	22	37
Cuba	10	3	2	12	28	30	17	15	26	58	116	130	13	14	24	57	108	115
Porto Rico, &c. ..	3	3	..	1	8	4	6	12	2	3	23	17	5	10	2	2	20	16
Manilla, &c.	40	10	..	..	50	46	31	20	1	2	54	44	20	21	2	2	45	38
Brazil	..	10	2	3	15	23	1	31	15	15	63	59	2	38	14	16	70	52
Beetroot, &c.	1	..	..	2	3	2	14	4	1	12	30	36	15	4	1	11	30	39
Total, 1869 ..	81	31	5	25	142	164	182	99	62	137	479	520	172	105	61	137	475	477
Total, 1868 ..	82	41	4	36	22decrease		191	98	54	177	41decrease		175	94	55	152	2 decrease	

STATE AND PROSPECTS OF THE SUGAR MARKET.

At the beginning of November, markets were firm for nearly all descriptions of raw sugar, and very little of the better class of West India being on offer, higher prices were paid for sugars of this description. During the next two or three weeks a different tone prevailed, and extreme dullness was the rule; but during the last few days rather more firmness has been displayed, but business has been checked by holders asking a slight advance. For refined of most descriptions lower prices have been taken, and the better classes of crushed and pieces may be quoted 1s. to 1s. 6d. below last month.

The extreme flatness of the market may be partly accounted for by the fact that the estimated continental beet sugar crop assumes larger proportions, as the facilities for forming a correct judgment are increased; the last estimate, according to Licht's circular, being 700,000 tons, or 80,000 tons in excess of last season. This, and the absence of sufficient data for judging of the probable supply of colonial sugar for the next few months, indispose both the refiners and the trade to buy, except for immediate wants.

As regards the future, it is difficult to speak with any degree of confidence. On account of the increased sugar production in Mauritius, it is probable that a much larger proportion than usual will reach the home market this season; on the other hand, there is in the United Kingdom a marked deficiency in the better class of raw sugars, and the stock consists in great proportion of the lowest description of goods, which represents a much smaller weight of sugar fit for consumption.

☞ *Communications and Advertisements to be addressed to the Editor of "The Sugar Cane," Galt & Co., Publishers, Manchester.*

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